PHYSICS ABSTRACTS

SECTION A

of

SCIENCE ABSTRACTS

SECTION A, PHYSICS

SECTION B, ELECTRICAL ENGINEERING

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Non-destructive testing	Applied electrochemistry	Amplifiers
Industrial radiography	Photocells	Radio-wave propagation
Corrosion	Thermionic tubes	Mechanical engineering
Electrical and magnetic measurements and instruments	Cathode-ray tubes	Heat engines
	X-ray tubes	Illumination
Electronic relays and counters	Induction accelerators	Metallurgy

NOTE ON THE ARRANGEMENT OF ABSTRACTS

The Abstracts are classified by subject according to the Universal Decimal Classification, and arranged in order of their U.D.C. numbers, which are printed at the head of the Abstract on the left. Abstracts on any particular subject can be located by first consulting the abridged tables of the U.D.C. published with the January number, or the Annual Alphabetical Subject Index, and then referring to the appropriate U.D.C. number in the text. The main headings are listed above.

An Abstract of interest under more than one head has additional U.D.C. numbers, linked by the colon sign, ":" e.g. "536.21 : 548.0 Conduction of heat in crystals." The Abstract is printed once only, under the main number, e.g. in the section "HEAT 536," but Cross-references are inserted under the other numbers, e.g. "548.0 : 536.21 *see Abstr.* 1234" in the section "CRYSTALLOGRAPHY 548." These Cross-references should be investigated, therefore, when a particular section is being searched, as they contain additional matter relevant to that section. A Cross-reference does *not* refer to the Abstract which appears immediately above it.

[*Continued on page* 3 *of cover*]

MATHEMATICS 51

517.564.4 3564

Approximations to a uniform magnetic field: roots of Legendre polynomials of even order. McKeehan, L. W. Note in *Rev. Sci. Instrum.*, **19**, 475 (*July*, 1948).—Some corrections to an earlier table [Abstr. 1877 (1936)].

517.944 : 621.3.012.8 3565

Electric circuit models of partial differential equations. Kron, G. *Elect. Engng, N.Y.*, **67**, 672–84 (*July*, 1948).—[Abstr. 2930 B (1948)].

517.947.43 : 517.948.3 : 536.24.02 *see Abstr.* 3732

517.947.43 : 517.948.32 : 536.24.02 *see Abstr.* 3733

517.947.44 : 534.131 : 531.391 *see Abstr.* 3614

517.948.3 : 517.947.43 : 536.24.02 *see Abstr.* 3732

517.948.32 : 517.947.43 : 536.24.02 *see Abstr.* 3733

518.5 : 621.314.12 : 621.392.5 3566

Design of d.c. electronic integrators. Korn, G. A. *Electronics*, **21**, 124–6 (*May*, 1948).—[Abstr. 2818 B (1948)].

519.2 : 530.162 = 82 *see Abstr.* 3612

519.2 : 539.155.2 = 3 *see Abstr.* 3871

519.2 : 548.7 *see Abstr.* 4021

519.24 3567

Systematic sampling. Yates, F. *Philos. Trans. A*, **241**, 345–77 (*Aug.* 31, 1948).

519.24 : 526.5 3568

A method of simultaneous solution of a system of observation and condition equations. Stearn, J. L., and Braaten, N. F. *Trans. Amer. Geophys. Un.*, **29**, 157–62 (*April*, 1948).—A new method is deduced for obtaining a solution to a system of observation equations which is constrained by a number of conditions. A most general case in least-squares theory is first formulated followed by an actual problem in geodesy. The results of this paper lead to the conclusion that the method is very well adapted to adjustment problems in area triangulation inasmuch as it is both efficient and flexible. A.

519.26 : 530.145 = 4 3569

Applications to mixed representatives of the theory of the transfer of random magnitudes [grandeurs aléatoires]. Bass, J. *C.R. Acad. Sci., Paris*, **226**, 1351–3 (*April* 26, 1948) *In French.*—A representative function is obtained for momentum-position variables, together with two conditions to be satisfied by it, and the degree of approximation to which these results correspond to quantum mechanics is briefly discussed. G. J. K.

519.3 : 530.12 = 82 *see Abstr.* 3588

ASTRONOMY . ASTROPHYSICS . GEODESY 52

521.038 : 538 : 530.1 *see Abstr.* 3583

521.112.1 : 523.112 : 530.12 = 4 *see Abstr.* 3589

522.612 3570

Photo-electric star-following telescopes. Uttley, A., Jones, S., and Manns, L. Letter in *Nature, Lond.*, **162**, 144 (*July* 24, 1948).—The automatic guiding of an astronomical telescope on a star was investigated, using a 13 in astrographic refractor at Greenwich. The servo-system mechanism is described. The random steady state error, when using the apparatus, is a few seconds of angle.

523.112 : 521.112.1 : 530.12 = 4 *see Abstr.* 3589

523.5 3571

A note on four complex meteor radar echoes. Millman, P. M., and McKinley, D. W. R. *J.R. Astr. Soc. Can.*, **42**, 121–30 (*May–June*, 1948).—The radar echoes of four bright meteors, one Geminid and three Lyrids, are studied in detail. All four echoes have an enduring portion of complex character, centred at a height of 90 km, and at least three have an instantaneous component which seems to move with the velocity of the meteor itself. Measurements made on these echoes indicate velocities of 35 km/sec for the Geminid shower and 48 km/sec for the Lyrid shower. A.

523.51 : 537.591 *see Abstr.* 3813

523.72 : 621.396.812.5 : 523.854.1 = 3 *see Abstr.* 3578

523.742 = 4 3572

On the polarisation of the light near the sun's limb. Pecker, J.-C. *C.R. Acad. Sci., Paris*, **226**, 1251–4 (*April* 19, 1948) *In French.*—Lyot's experimental results obtained with his new polarimeter [Abstr. 2659–60 (1948)] are discussed and well represented by theoretical developments (on the basis of recent work by Chandrasekhar) [Abstr. 2465 (1947)], which e.g. lead to a numerical value of $2{\cdot}1 \cdot 10^{-5}$ for the fraction of polarized light in a circular area of 1′ diameter centred 1′ from the sun's limb. A. B.

523.77 3573

Lines of methane at 7·7 μ in the solar spectrum. Migeotte, M. V. Letter in *Phys. Rev.*, **74**, 112–13 (*July* 1, 1948).

523.8 3574

The photoelectric temperatures of the P Cygni stars. Beals, C. S., and Hatcher, R. D. *Canad. J. Res. A*, **26**, 149–66 (*May*, 1948).—The temperatures of 52 P Cygni stars of spectral type from A4 to O5 were determined from emission lines by Zanstra's method. For approx. half the stars, accurate spectrophotometric measures of emission line intensities were available and for the remainder the intensities were estimated on the basis of published descriptions of spectra. The computed temperatures were found to range from 10 000° to 42 000°K, and after smoothing by graphical methods a temperature scale for the O, B, and A type stars showed the following values: A0, 16 000°; B0, 35 000°; O5, 40 000°K. Comparisons are made with temperatures derived by other methods, and reasons are given for attributing greater weight to the values from B0 to O5 than to those in the lower range of the sequence. A.

523.842 3575

Reflection effect in eclipsing binaries for a point-source of light. Sen, H. K. *Proc. Nat. Acad. Sci., Wash.*, **34**, 311–17 (*July* 15, 1948).—The effect has been evaluated, correct to the 4th power of the ratio of the radius of the illuminating star to the distance between the two stars, on the hypothesis of a cosine law of reflection. A.

523.852.3 : 530.12 = 4 3576

The recession of the extra-galactic nebulae. III. Drumaux, P. *Ann. Soc. Sci., Brux.*, **62** (*Sér.* 1) 74–82 (*May* 25, 1948) *In French.*—The coefficients $a_{\mu\nu}$ defining the space distribution of nebula velocities [Abstr. 1754 (1948)] could be determined from the Doppler effects for 6 pairs of nebulae; the degree of precision that would be necessary in the measurement of the Doppler shifts is discussed. R. A. N.

523.854 3577

Discrete sources of galactic radio frequency noise. BOLTON, J. G. Letter in *Nature, Lond.*, **162**, 141–2 (*July* 24, 1948).—About ¼ of the celestial sphere was searched for sources of noise other than that reported previously [Abstr. 1393 (1948)]. Six new sources were found. These are in regions of relatively low noise-brightness and star-density. The question of the origin of galactic noise is discussed.

523.854.1 : 523.72 : 621.396.812.5 = 3 3578

Short-wave radiation from the Milky Way and the sun. UNSÖLD, A. *Naturwiss.*, **34** (*No.* 7) 194–201 (1947) *In German.*—The fact that the intensity of cosmic noise varies with galactic longitude in the same general way at all observed wavelengths shows that up to at least 7·5 m the Milky Way is optically thin, and thus that its radiation is less than that given by the Planck function. The observed dependence of the absolute intensity on frequency is consistent with an origin in free-free transitions of electrons in the field of protons, the electron density being $1 \cdot 5\ \mathrm{cm}^{-3}$ and the effective temperature 10^5 °. The effective temperature of the sun's chromosphere and corona is calculated at wavelengths from 10 m to 3 cm. The sun and corona form a uniformly bright disc radiating at 5×10^5 ° at 10 m, but at 10 cm the corona is optically thick only at the limb, and the effect is of a bright ring round a disc radiating at only 2×10^4 °. The effect of solar disturbances in enhancing the effective temperature is discussed. A. HU.

523.87 : 539.153 3

Electromagnetic level-shift and effect of radiation fi KOTHARI, D. S., AND AULUCK, F. C. Letter in *Nat Lond.*, **162**, 143 (*July* 24, 1948).—The astrophys significance of the observed level-shift [Abstr. 3 (1947)] and Bethe's theory [Abstr. 3608 (1947)] is poin out; the shift in the Balmer lines is comparable to Einstein solar red-shift; and the 2*S* state will behave a metastable state. An expression is given for the crease in transverse self-energy of a free electron due the radiation field, but the effect on an atomic electro more complicated.

523.877 3

A perturbation problem in the theory of stellar structu REIZ, A. *Ark. Mat. Astr. Fys.*, **35 A** (*Paper* 29) 15 (1948) *In English.*—From an assumed law of ener production, and using the Kramers–Eddington opac law, the variation in $\kappa\eta$ throughout a star is determin on the basis of the standard model. Chandrasekha development of Strömgren's perturbation theory adapted for a detailed numerical solution. Calculatio are made with $\varepsilon \sim T^n$, $n = 1, 2, 3, 4$ for various valu of β_c. R. A.

525.24 : 538 : 530.1 *see Abstr.* 3584

525.735 : 551.593.5 *see Abstr.* 4069

525.75 : 551.593.51 = 4 *see Abstr.* 4070

526.5 : 519.24 *see Abstr.* 3568

PHYSICS 53

53.081 : 621.3.081 = 4 3581

Co-ordination of the electrical and mechanical units in a "practical" international system: classical or rationalized formulae? FLEURY, P. *J. Phys. Radium.* (*Sér.* 8) **9**, 33–8 (*Feb.*, 1948) *In French.*—[Abstr. 2620 B (1948)].

53.081.5 : 539.3 *see Abstr.* 3967

53.087 : 621.318.572 3582

An "electrical memory" for stepping recorders. IVES, R. L. *Trans. Amer. Geophys. Un.*, **29**, 331–4 (*June*, 1948). —Methods of storing impulses applied to a stepping type recorder during the recording and homing cycle, and of transferring the stored record to the main record after homing is completed, are here outlined. A.

FUNDAMENTALS 530.1

530.1 : 521.038 : 538 3583

Comments on the theories interpreting the magnetism of celestial bodies. FORRÓ, M. Letter in *Phys. Rev.*, **74**, 218–19 (*July* 15, 1948).

530.1 : 525.24 : 538 3584

The dipole moment of the supposed fundamental magnetic field rotation. CHAPMAN, S. *Proc. Phys. Soc., Lond.*, **61**, 95 (*July*, 1948).—Correspondence regarding Blackett's recent discussion of the magnetic fields of the earth, sun and stars [Abstr. 1715 (1947)]. It is shown that if P is the dipole moment and v the angular momentum of a rotating body possessing symmetry about an axis of revolution, then P/v is independent of the density distribution of the body, and of its angular velocity. L. S. G.

530.1 : 539.11 3585

Systematic relations existing between the properties of solid materials. ZWIKKER, C. *Physica, 's Grav.*, **14**, 35–47 (*Jan.*, 1948) *In English.*—Any two variables of state of a given substance, whose product has the dimension of work, are connected by relations involving moduli and constants of the material of the said substance. Th implies the existence of analogies between any such pa of variables and any other homologous pair (i.e. whc product has the dimension of work), and likewise betwe the corresponding moduli and constants. Examples several analogies of this kind are given and discussed. G.

530.12 35

Foundations of relativity. I–II. WALKER, A. G. *Pro Roy. Soc., Edinb., A*, **62** (*Pt III*) 319–35 (1948).—The bas of kinematical relativity is derived from a small set axioms in the manner of projective geometry. The wo includes the derivation of the properties of collinear se of fundamental particles, but leaves the discussion of t 3-dimensional substratum to a later paper. The axion chosen are also consistent with general relativity exce when positive space-curvature leads to the multip reception of light signals. H.

530.12 = 4 35

On the integration of the problem of initial conditions relativistic mechanics. FOURÈS-BRUHAT, Y. *C.R. Aca Sci., Paris*, **226**, 1071–3 (*March* 31, 1948) *In French.* Discusses the determination of space-time, being give the components of the energy-momentum tensor over hypersurface. R. A.

530.12 : 519.3 = 82 35

Field theory of delayed particles. BLOKHINTSEV, D. *J. Exp. Theor. Phys.*, **18**, 566–74 (*June*, 1948) *In Russian.* Relativistic-invariant electromagnetic field theory, base on the admission of the possibility of the propagation the interaction in small space-time regions with a veloci exceeding that of light.

530.12 : 523.112 : 521.112.1 = 4 35

On Milne's cosmology. Proof of the relation $G(\xi) = -$ for simple kinematical systems. CAUSSE, M. *C.R. Aca Sci., Paris*, **226**, 876–8 (*March* 15, 1948) *In French.* The kinematical system is regarded as the limit of

statistical system when $\xi \to 1$ for all particles. The singularity in $\psi(\xi)$ at $\xi = 1$ is discussed. R. A. N.

530.12 : 523.852.3 = 4 *see Abstr.* 3576

530.12 : 530.145 *see Abstr.* 3597

530.12 : 530.145.6 = 82 3590

General relativistic invariant equations and infinite representations of the Lorentz group. GELFAND, I. M., AND YAGLOM, A. M. *J. Exp. Theor. Phys.*, **18**, 703–33 (*Aug.*, 1948). [Abridged note *C.R. Acad. Sci. URSS*, **59** (*No.* 4) 655–8 (1948)] *In Russian.*—The equations considered are of the form

$$\Sigma L^l \partial\psi/\partial x^l + i\kappa\psi = 0$$

where the L^l are linear transformations (matrices) in a certain space. The equations invariant to the Lorentz group are discussed and some methods devised in Russia for deriving infinite irreducible representations from an invariant Lagrange function are described. The conditions under which this holds are discussed. The possible values of particle spin and the corresponding mass spectra are considered. Examples of invariant equations in finite and infinite numbers of dimensions are given, including infinite-dimensional equations, corresponding to positive charge and energy, respectively. L. S. G.

530.12 : 531.18 3591

Einstein's equivalence principle and the problem of blind navigation. GILVARRY, J. J. Letter in *Phys. Rev.*, **73**, 1409–10 (*June* 1, 1948).—The limitations of the information which can be obtained from a vehicle-borne accelerometer are discussed, but no unexpected results are found. The final conclusion is of no relevance to the equivalence principle. H. B.

530.12 : 531.51 3592

A gravitational field with a curious geometrical property. NARLIKAR, V. V., AND KARMARKAR, K. R. Letter in *Nature, Lond.*, **162**, 187 (*July* 31, 1948).—A Riemannian metric is given, for which the curvature tensor does not vanish, although the 14 scalar differential invariants are zero. H. B.

530.14 3593

On the classical equations of motion of point charges. HAVAS, P. *Phys. Rev.*, **74**, 456–63 (*Aug.* 15, 1948).—Various field-theories are discussed. The considerations of Wheeler and Feynman [Abstr. 733 (1946)] on the total field due to all particles of the universe are applicable to field theory in the symmetric form as well as to action-at-a-distance theory. The acceptance of their condition of "complete absorption" again leads to the radiation damping term in the equations of motion of the many-body problem. Some implications of this result are discussed. A

530.14 : 537.122 3594

On the classical theory of particles. ELIEZER, C. J. *Proc. Roy. Soc. A*, **194** (*No.* 1039) 543–55 (1948).—A set of classical relativistic equations of motion of an electron in an electromagnetic field is postulated. These equations are free from "run-away" solutions, and give the same results as the Maxwell–Lorentz theory for non-relativistic motions when the external electromagnetic field does not vary too rapidly. For the scattering of light by an electron, the scattering cross-section is independent of the frequency and is a universal constant. This brings out a point of difference from the Lorentz–Dirac equations according to which the scattering cross-section varies inversely as the square of the frequency of the incident light, for large frequencies. For the motion of an electron towards a fixed proton, the equations allow a collision, unlike the Lorentz–Dirac equations according to which the electron is brought to rest before it reaches the proton. A.

530.14 : 538.632 = 4 *see Abstr.* 3842

530.14 : 539.152.1 3595

On Schwinger's theory of nuclear forces. RAMSEY, W. H. *Proc. Phys. Soc., Lond.*, **61**, 297–9 (*Oct.*, 1948).—It is shown that Schwinger's generalization of the Møller–Rosenfeld theory cannot consistently be used to describe nuclear forces. It does not lead to the correct quadrupole moment of the deuteron, and it offers no hope of a detailed agreement with proton–proton scattering. A.

530.145 3596

On a refinement of the W.K.B. method. IMAI, I. Letter in *Phys. Rev.*, **74**, 113 (*July* 1, 1948).—The method is essentially concerned with the asymptotic solution of the equation $d^2\phi/dx^2 + k^2P(x)\phi = 0$ for $k \to \infty$. Solutions are well known for $P(x)$ positive or negative. The present paper gives an approximate expression for ϕ near the turning point, where $P(x)$ changes its sign. L. P.

530.145 : 519.26 = 4 *see Abstr.* 3569

530.145 : 530.12 3597

The quantization of space and time. FLINT, H. T. *Phys. Rev.*, **74**, 209–10 (*July* 15, 1948).—In the 5-dimensional formalism of Snyder [Abstr. 1120 (1947)] the extra co-ordinate x_5 can be associated with the Compton wavelength (h/mc) of the particle described. The expectation values of time and space variables then contain terms which can be jointly interpreted as meaning that no physical significance can be attached to proper time intervals $< (h/mc^2)$. G. J. K.

530.145 : 535.393 = 4 *see Abstr.* 3716

530.145 : 536.71 3598

Quantum theory of condensed permanent gases. II. The solid state and the melting line. DE BOER, J., AND BLAISSE, B. S. *Physica, 's Grav.*, **14**, 149–64 (*April*, 1948) *In English.*—Regularities in the equation of state [Abstr. 2460 (1948)] are considered. Influence of quantum theory on the zeropoint volume and energy is calculated. The solid state and the solid–liquid equilibrium is considered from the order–disorder theory of Lennard–Jones [Abstr. 619 (1940)].

530.145 : 537.133 : 539.185 3599

The effect of non-central forces on the collisions of high energy neutrons with protons. MASSEY, H. S. W., BURHOP, E. H. S., AND HU, T.-M. Letter in *Phys. Rev.*, **73**, 1403–4 (*June* 1, 1948).—Calculations were made with 3 square-well potentials differing only by a factor which was either (*a*) charge-symmetric $(\tau_1 . \tau_2)$, (*b*) charge-exchange $\frac{1}{2}(1 + \tau_1 . \tau_2)$, or (*c*) a constant. The effect of the non-central force in the first two was to decrease the anisotropy expressed either as total variation with angle or as the ratio of backward to forward scattering; with the third the effect was not so pronounced. G. J. K.

530.145 : 537.133 : 539.185 3600

The neutron-proton scattering formula. EISENBUD, L. Letter in *Phys. Rev.*, **73**, 1407–8 (*June* 1, 1948).—The resonance energy used by Flugge and Hückel [Abstr. 2013 (1948)] as the deuteron singlet state energy bears no relation to the energy defined by Bethe. It is incorrect, therefore, to suggest that the difference in their magnitudes has any physical significance. G. J. K.

530.145 : 537.133 : 539.185 3601

On the neutron-proton force. BLATT, J. M. *Phys. Rev.*, **74**, 92–6 (*July* 1, 1948).—The results of a variation method are given for the n–p scattering cross-section (S-wave only) and the deuteron binding energy as an expansion in terms of scattering lengths and effective force ranges for the triplet and singlet states. The first

terms do not depend on the law of force, and are sufficient up to 8 MeV. Using these, it is shown that the scattering up to this energy is not sufficient to determine the effective ranges of the *n–p* forces in the two states (owing to the magnitudes of the deuteron constants). However, using the results on coherent scattering by para-hydrogen and in crystals, it is deduced that the effective triplet range lies between $1{\cdot}3$ and $1{\cdot}55\times10^{-13}$ cm, and the effective singlet range $< 2\times10^{-13}$ cm, in contradiction to the charge-independent hypothesis. These conclusions are only invalid if the potential has a large "tail" at great distances, so that further terms in the expansion are necessary. G. J. K.

530.145 : 537.133 : 539.185 = 4 3602

On the problem of the neutron and the proton. VRKLJAN, V. S. *J. Phys. Radium* (*Sér.* 8) **9**, 26–32 (*Jan.*, 1948) *In French.*—The Dirac electron theory is extended to an 8-dimensional matrix representation, acting on two spinors. By associating suitable charge constants with these it is possible to describe particles with the correct charge and magnetic moment for the proton and neutron. The spin of the particles is found to be $\frac{1}{2}$. G. J. K.

530.145 : 538.3 3603

On infinite field reactions in quantum field theory. TOMONAGA, S.-I. Letter in *Phys. Rev.*, **74**, 224–5 (*July* 15, 1948).—This contains a summary of recent work in Japan, along the same lines as recent papers [cf. Abstr. 1432 (1948)], attempting to deal with the electronic self-energy problem in radiation theory. There is also a discussion on the elimination of terms, believed to be infinite, which are attributed to a vacuum polarization effect, i.e. the photon self-energy. G. J. K.

530.145 : 538.3 = 82 3604

The classical analogue of the quantum theory of excitation. MARKOV, M. A. *J. Exp. Theor. Phys.*, **18**, 510–14 (*June*, 1948) *In Russian.*—A theory of excitation by expanding the action function in terms of a small charge (as a parameter) is developed on the lines of classical electrodynamics based on the Hamilton–Jacobi method. This is the classical analogue of the quantum theory of excitation. In a second approximation of the theory of excitation the eigen-energy of a fast electron (analogue of Waller's quantum formula), and the inter-reaction of two fast electrons (*a* of Møller's formula) are computed. It is well known that the method of successive approximations, based on the smallness of the charge, is extensively made use of in quantum mechanics. The author shows that an analogous method may also be applied in the classical theory. In quantum theory, however, the method meets with some difficulties, and it is therefore interesting to consider its classical analogue under this angle of view and to separate the systematical difficulties of the theory from the errors of the particular expansion. The method is made clear by 2 examples. A.

530.145 : 539.152.1 : 539.175 = 4 3605

Nuclear forces and the principle of respective co-ordinate systems. DESTOUCHES-FEVRIER, P. *C.R. Acad. Sci., Paris*, **226**, 878–80 (*March* 15, 1948) *In French.*—Using this principle an uncertainty constant appears in interaction energies between particles, and divergences are eliminated. The revised meson potential is given. To any meson involved in nuclear forces there is now a characteristic energy associated with the nucleon, and it is suggested that different mesons giving the same characteristic energy may be involved simultaneously in the interaction. G. J. K.

530.145 : 539.18 = 4 3606

The relation between meson masses. CAZIN, M. *C.R. Acad. Sci., Paris*, **226**, 880–2 (*March* 15, 1948) *In French.*—Following the suggestion of Destouc Fevrier [Abstr. 3605 (1948)] calculations show that mesons can be involved in general in nuclear interacti If their mass ratio is $r = 1{\cdot}8$ their separate masses 320 and $176m_e$, and if $r = 1{\cdot}65$ they are 312 $190m_e$. G.

530.145 : 539.185 *see Abstr.* 3957

530.145.6 = 4 3

On the passage of waves of particles of spin $\frac{1}{2}h$ ac barriers due to nuclear fields. PETIAU, G. *Rev. Paris*, **85**, 1094–106 (*Dec.* 1 *and* 15, 1947) *In Frenc* Transmission and reflection coefficients are calcula using plane wave solutions of the Dirac equation fc potential barrier of constant height V and either finit infinite width of the form VM, where M is unity or of the other 15 Dirac α-matrices. Solutions are found for interactions represented by certain lir combinations of the VM. G. J.

530.145.6 = 4 3

Characteristic functions applied in the quantum the of fields. D'ESPAGNAT, B. *C.R. Acad. Sci., Paris*, 2 1175–7 (*April* 12, 1948) *In French.*—The method viously applied to the harmonic oscillator [Abstr. 1 (1948)] for the time variation of mean co-ordinate momentum values is also applicable to any prob where the Hamiltonian is merely of the second degree these pairs of canonically conjugate variables. G. J.

530.145.6 : 530.12 = 82 *see Abstr.* 3590

530.145.6 : 530.161 = 82 3

Interpretation of a wave function applied to the pa FOCK, V. A. *J. Exp. Theor. Phys.*, **18**, 737–40 (*A* 1948) *In Russian.*—In quantum mechanics the w function is usually applied to the calculation of pro bilities referring to future measurements on the basis results of preceding measurements. However, un known conditions it may also be used for calculat probabilities of past events from the data of later measu ments. The said conditions are formulated and a form for probabilities of past events is derived. This form contains essentially *a priori* probabilities.

530.145.6 : 537.12 : 548.0 = 82 *see Abstr.* 4015

530.145.6/.7 : 531.314.2/.3 3

The approximate solution of one-dimensional wa equations. ECKART, C. *Rev. Mod. Phys.*, **20**, 399–4 (*April*, 1948).—The first half discusses the application the method of stationary phase to the examination of Fourier integral solution of wave-equations in t variables, and its relation to the Hamilton–Jac equation. The approximations to be used with t method near the wave-front are discussed in some det and the conditions of validity examined. Eventual difficulties of the method are made apparent wh propagation in dissipative media is considered, a integration in a complex plane is necessary for evaluati the approximation. The method of steepest descents introduced at this stage. G. J.

530.145.6/.7 : 539.152.1 = 3 3

Contributions to the pair theory of nuclear forc WENTZEL, G. *Z. Phys.*, **118** (*Nos* 5–6) 277–94 (19 *In German.*—The variation of static nuclear forces w distance is calculated by an "exact" method using a p of particles of spin $\frac{1}{2}$. The calculations are unalte whether the spin is assumed $\frac{1}{2}$ or integral, and a sca pair theory is therefore used to find the relation. Co paring the results with the second approximation obtai from the perturbation method, it is found that the la gives a correct relationship, but too high an absol value for the forces. V. W.

530.145.61/.62 : 535.332 : 539.152.1 = 3 *see Abstr.* 3863

530.161 : 530.145.6 = 82 *see Abstr.* 3609

530.162 : 519.2 = 82 3612

Determination of distribution functions for non-equilibrium systems with transmission phenomena. Weinreb, E. A., and Spivak, J. V. *J. Exp. Theor. Phys.*, **18**, 539–47 (*June*, 1948) *In Russian.*—The systems considered are regarded as stationary, though not in equilibrium. The distribution functions are found for cases where neutral matter or charges, forces and moments are transmitted through a system of particles. The function is determined for a system in which there are temperature and concentration gradients, and electric and magnetic forces act simultaneously. The computation is carried through on the Maxwell–Boltzmann, Fermi, and Bose–Einstein statistics. It is shown in which cases there are deviations from the Maxwellian distribution in the electron-gas plasma. A comparison is made with the results of Lorentz and Gans obtained from solutions of the kinetic equation. The peculiarity of the semi-thermodynamical method as generalized by the authors is to be seen in that the distribution functions may be found without any assumption on the mechanism of interaction between the particles. The consideration of transmission problems independently of the type of statistics used, and the determination of the distribution in presence of a magnetic field, with transmission of moments due to mechanical, magnetic or convective electric forces, generalizes the semi-thermodynamical method of finding the distribution functions. The method shows on which combination of co-ordinates and velocities in the setting up of the kinetic equation the distribution functions must depend. A.

GENERAL MECHANICS . MECHANICS OF SOLIDS 531

531.18 : 530.12 *see Abstr.* 3591

531.314.2/.3 : 530.145.6/.7 *see Abstr.* 3610

531.382 3613

A ball-bearing drive for the ultracentrifuge. Ecker, P. G., and Blum, J. *Rev. Sci. Instrum.*, **19**, 399–400 (*June*, 1948).—A design for a simple stable ball-bearing support for ultracentrifuge turbines is presented. The ball-bearing drive eliminates the axial oscillations associated with the use of the air bearing. A.

531.391 : 534.131 : 517.947.44 3614

The solution of natural frequency equations by relaxation methods. Cooper, J. L. B. *Quart. Appl. Math.*, **6**, 179–83 (*July*, 1948).—The equations relate to systems with a finite number of degrees of freedom. Two conditions for convergence in the relaxation method are given. If one is satisfied the process converges to the highest mode; if the other is satisfied, to the lowest. A process for finding other modes is outlined. L. S. G.

531.391.3 : 531.539 = 4 *see Abstr.* 3616

531.44 3615

Measurement of the slipperiness of walkway surfaces. Sigler, P. A., Geib, M. N., and Boone, T. H. *J. Res. Nat. Bur. Stand., Wash.*, **40**, 339–46 (*May*, 1948).—The mechanics of walking as related to slipping and the design of testing instruments are briefly discussed. In order to test floors in actual service a portable slipperiness tester of the pendulum-impact type was designed and constructed. The design is based on the hypothesis that, in the process of ordinary walking, slipping is most likely to occur when the pavement surface is first contacted by the edge of the heel. The instrument and test procedure are described. The effects of varying some of the constants of the instrument, such as the angle of contact between the test heel and the pavement surface, and the pressure between the heel and the pavement, are discussed. Typical results obtained with both rubber and leather test heels and under both dry and wet conditions are given for various flooring and finishing materials. In general, the traction furnished by dry rubber heels is much better than that obtained with dry leather heels. Good antislip properties under wet conditions are usually associated with rough particles that project through the film of water and thus prevent its action as a lubricant. A.

531.51 : 530.12 *see Abstr.* 3592

531.539 : 531.391.3 = 4 3616

On the asymptotic motion of a pendulum after a very large number of successive impulses applied by corpuscles. Hostinský, B. *C.R. Acad. Sci., Paris*, **226**, 990–2 (*March* 22, 1948) *In French.*—Impulses are applied to the pendulum, of period τ_1, at regular intervals τ; an equation is obtained connecting the increase of velocity of the pendulum due to the nth impulse with the next three gains in succession. By solving an equation of finite differences the effect of the nth impulse expressed in terms of velocity increase is determined: and the resultant displacement effect of n impulses following by summation of terms is a function of (t, n, τ, τ_1). The asymptotic value of the displacement, with $t \to \infty$, $n \to \infty$, represents an oscillatory motion about a centre at a distance from the equilibrium position of the pendulum bob which is inversely proportional to τ. With $\tau = \tau_1$ the oscillation is about the equilibrium position of the bob. These results apply to oscillatory motions of an electron acted on by a train of photons. G. G.

531.539.2 = 4 3617

On some experiments made with two resonating pendulums. Sălceanu, C., and Borneas, M. *C.R. Acad. Sci., Paris*, **226**, 992–4 (*March* 22, 1948) *In French.*—Observations of the period of amplitude variation in relation to the traction applied to the pendulums are recorded, in continuation of results recorded in a previous paper [Abstr. 3066 (1947)]. The wires tested are of various materials. With increasing traction the period increases up to a final value close to the theoretical value, the approach to saturation value being slower, the less rigid the material of the wire. The observed variation in period with increase in traction is accounted for as being due to curvature of the wire produced by the weights of the pendulums. G. G.

531.555 3618

A radio method of studying the yaw of shells. Gotlieb, C. C., Pashler, P. E., and Rubinoff, M. *Canad. J. Res. A*, **26**, 167–98 (*May*, 1948).—A new method of investigating the angular motion of a shell in flight is described. The fuse of the shell is replaced by a h.f. transmitter and the radiated signal is recorded at a ground station. The theory of the method is given, the equipment described, and the procedure in the analysis of the records is discussed. Results of experiments are quoted and values of the force coefficients are deduced. In addition to those coefficients usually determined by jump card experiments, certain other coefficients, involving spin, are evaluated. The method is compared with others. A.

531.6 3619

Impulse determinations of rockets by means of rotating systems. Penner, S. S., and Whiteman, R. C. *Rev. Sci. Instrum.*, **19**, 428–35 (*July*, 1948).—Two simple rotating systems were designed for the determination of the impulse of rocket propellants. The pin wheel consists of a bicycle wheel mounted horizontally in a steel frame.

A small rocket motor containing the propellant which is to be tested is mounted on the wheel so that the thrust delivered by the rocket accelerates the speed of rotation of the wheel. A photographic record of the rotational speed is then used to calculate the impulse delivered as a function of the time. The rotating bar is operated in a manner similar to that of the pin wheel. The rotating systems were used for the determination of relative effective gas velocities of a number of double-base rocket powders. Impulse measurements of miniature rockets of the order of 1 lb/sec were made. An investigation of the effect of expansion ratio of rocket nozzles on the reduced specific impulse showed good agreement with theoretical calculations. A.

531.66 : 532,528 *see Abstr.* 3632

MECHANICAL MEASUREMENTS 531.7

531.715 : 621.317.39 = 3 3620

An electrical precision method for the measurement of drill holes. POTTHOFF, K., AND KESER, F. *Z. angew. Phys.*, **1**, 61–6 (*March*, 1948) *In German.*—[Abstr. 2712 B (1948)].

531.72 : 533.15 *see Abstr.* 3645

531.728 : 539.27 : 539.217 *see Abstr.* 3963

531.752 : 533.5 3621

Apparatus for weighing in vacuum. MONK, G. W. *J. Appl. Phys.*, **19**, 485–6 (*May*, 1948).—The apparatus described may be used to measure the weight of a sample in a vacuum (0·01 micron) at temperatures up to about 700°C. Typical preliminary results are given for the outgassing of aluminium, carbon, and "Teflon." A.

531.761 : 621.318.5 : 621.317.39 = 396 3622

An instrument for measuring relay operation time. TROLLDALEN, A. *Elektrotek. Tidsskr.*, **61**, 235–8 (*July*, 1948) *In Norwegian.*—[Abstr. 2714 B (1948)].

531.765 : 621.317.39 3623

A spiral chronograph for long time intervals. WARSHAW, H. D. *Rev. Sci. Instrum.*, **19**, 420–4 (*July*, 1948).—[Abstr. 3020 B (1948)].

531.768 : 621.317.39 3624

A pick-up for the measurement of quasi-static angular acceleration. STATHAM, L. *Rev. Sci. Instrum.*, **19**, 381–4 (*June*, 1948).—Design parameters for an angular accelerometer are developed. It incorporates an electrical sensing element which may be energized by dry cell batteries and whose output may be connected directly to a recording galvanometer. A.

531.775 : 621.317.39 3625

Tachometer testing facilities increased electronically. CHAMBERLAIN, H. H. *Gen. Elect. Rev.*, **51**, 15–18 (*May*, 1948).—[Abstr. 3022 B (1948)].

531.788 3626

The vacuum divider: a low pressure multiplier. MONK, G. W. *Rev. Sci. Instrum.*, **19**, 396–8 (*June*, 1948).—An instrument utilizing a 5-litre/sec diffusion pump is described which allows pressures in the range 0·01 to 5 μ to be measured on a Pirani, thermocouple, McLeod or any other gauge ordinarily operating in the 0·5–50 μ range. A.

531.788.7 3627

A strain-sensitive resistance wire manometer. KEENAN, A. G., AND MCINTOSH, R. L. *Rev. Sci. Instrum.*, **19**, 336–9 (*May*, 1948).—A manometer employing a metal bellows and strain-sensitive resistance wire is described. By varying the diameter of the bellows and of the wire, gauges with sensitivities from 0·003 mm Hg, in the range 0–12 mm, to 0·8 mm Hg, in the range 0–200 m were obtained. The gauges showed hysteresis and poi on their calibration curves were reproducible only $\pm 0{\cdot}04$ mm and $\pm 0{\cdot}7$ mm, respectively. Experime in which the wire alone was loaded showed that a la part of these effects was due to the particular w used.

MECHANICS OF LIQUIDS 532

532.133 : 541.64 : 532.72 *see Abstr.* 3640–1

532.137 36

A correction in viscometry due to varying hydrosta head. CAFFYN, J. E. *Proc. Phys. Soc., Lond.*, **61**, 367– (*Oct.*, 1948).—The varying head gives rise to a correcti to the viscosity if the latter is calculated from the appli pressure only. This is worked out in general; and t special cases of viscometers with cylindrical and biconi bulbs and cylindrical bulbs with conical ends are co sidered in detail.

532.517.4 = 3 36

Moderately turbulent flow. HAMEL, G. *Z. angew. Ma Mech.*, **28**, 65–72 (*March*, 1948) *In German.*—A tu bulence function $T^2(\bar{y})$ may be introduced without a particular assumptions into the consideration of a plan steady, moderately turbulent flow in a parallel strip the simple introduction of a function ψ as an addition independent variable beside it, and by neglecting terr involving γ^2. ($\bar{y}$ is the average of y for constant ψ $T^2(\bar{y})$ then has the constant boundary value 1 and els where is >1, except for a laminar flow. There is univalent mutual relation between turbulence functio and velocity distribution. The average value of t pressure drop for constant ψ contains no contributio due to acceleration.

532.52 36

Relativistic Rankine–Hugoniot equations. TAUB, A. H *Phys. Rev.*, **74**, 328–34 (*Aug.* 1, 1948).—The stress energ tensor and the mean velocity vector of a simple ga are expressed in terms of the Maxwell–Boltzman di tribution function. The rest density ρ^0, pressure, and internal energy per unit rest mass ε are defined i terms of invariants formed from these tensor quantities It is shown that ε cannot be an arbitrary function of and ρ^0 but must satisfy a certain inequality. Thu $\varepsilon = (1/\gamma - 1)p/\rho^0$ for $\gamma > 5/3$ is impossible. It is know that if ε is given by this relation and $\gamma > 2$, then soun velocity in the medium may be greater than that of ligh in vacuum. This difficulty is removed by the inequalit mentioned above. The relativistic form of the Rankine Hugoniot equations is derived and it is shown that a a consequence of the inequality mentioned earlier th shock wave velocity is always less than that of light i vacuum for sufficiently strong shocks. A

532.525 : 536.423 36

Temperature and pressure phenomena in the flow o saturated liquids. SILVER, R. S. *Proc. Roy. Soc. A*, 19 (*No.* 1039) 464–80 (1948).—The rate at which evapora tion can occur from a surface is limited by the rate o heat flow into the surface. Because of this, when liquid at its boiling point commences to flow, the propor tion of vapour which forms as a result of the Bernoull fall in pressure is less than is calculated from adiabati expansion. A theory for the actual amount of vapou which will form is given, together with an analysis of it effect upon the velocity of flow and the quantity of flui passed by a nozzle. It is found that although the systen consists of a central core of liquid and an envelope o vapour, the calculated limiting velocity of flow, which i

the velocity of pressure propagation in the system, is low. The order of magnitude is 20 m/sec as compared with 400 and 1 500 m/sec for vapour alone and liquid alone respectively. There is a corresponding critical pressure, analogous to that in a gas nozzle, but in contrast to the gas case, both the critical pressure and the limiting velocity itself are functions of the diameter and length of nozzle. Experiments are described which confirm these theoretical deductions in all respects, and which also show good quantitative agreement with calculated velocities, critical pressures, and amount of discharge and of evaporation. On the basis of this experimental verification general phenomena to be expected in pressure propagation through liquids near saturation temperature are discussed. A.

532.528 : 531.66 3632

The impact of a solid on a liquid surface. RICHARDSON, E. G. *Proc. Phys. Soc., Lond.*, **61**, 352–67 (*Oct.*, 1948).—A study of the motion of a solid sphere when it strikes a liquid surface vertically is made. The shape of the air cavity formed is delineated and explained in terms of potential flow and the resistance experienced by the sphere in this stage is measured. These factors are found to scale on the basis of a Froude parameter. The pressure developed in the cavity is also measured and found to involve reverberations in the cavity of large amplitude. The impact forces on the sphere and other forms of projectile on entry into the liquid are studied and compared with theory. The mechanism and forces involved when a sphere ricochets after entry at oblique angles are also discussed. A.

532.543 3633

Unsteady flow in open channels. PUTMAN, H. J. *Trans. Amer. Geophys. Un.*, **29**, 227–32 (*April*, 1948).—Massau's original papers treat more complicated cases, but a résumé based on the special case of flow in rectangular channels illustrates the general line of attack. A.

532.543 : 627.84 = 5 3634

Rectangular canals with lateral afflux. CITRINI, D. *Energia Elett.*, **25**, 155–66 (*April*, 1948) *In Italian.*—[Abstr. 3107 B (1948)].

532.592 3635

Gradual damping of solitary waves. KEULEGAN, G. H. *J. Res. Nat. Bur. Stand., Wash.*, **40**, 487–98 (*June*, 1948).—The problem of the damping by viscous action of translation waves is treated. A short exposition is given of Boussinesq's boundary layer theory for wave motion, and expressions for the damping of rectangular and solitary waves are derived. Scott Russell's experimental results for solitary waves are compared with the theory, and satisfactory agreement is found to exist. This fact makes it legitimate to apply the formulae developed to correct in model tests on harbours or in other tests of a like nature for the dissipative effects that occur in shallow-water waves. A.

CAPILLARITY 532.6

532.612.4 3636

The surface tension of chloroform. FANELLI, R. *J. Amer. Chem. Soc.*, **70**, 1792–3 (*May*, 1948).—Using the max. bubble pressure method values for γ of $CHCl_3$ were obtained at 20° (27·16) and 25° (26·53 dynes/cm). The values are compared with recorded data. W. R. A.

532.694 : 536.423.15 = 3 3637

Observations on small liquid drops. II. RUMPF, E., AND NEUGEBAUER, N. *Z. Phys.*, **118** (*Nos* 5–6) 317–24 (1941) *In German.*—Extending the investigations of Rumpf and Geigl [Abstr. 559 (1939)] on liquid drops in suspension, the authors find that increase in vapour press. due to capillary forces affects only very small drops $< 10^{-4}$ cm radius, but that decrease of humidity below 100% greatly affects the size of drop. The relation between concentration and relative humidity is determined. For a given humidity drops of all sizes may occur provided their concentrations correspond to the humidity. Experiments corroborate the theory fairly closely. V. W. R.

532.694.1 3638

Foaming of mixtures of hydrocarbons. ROBINSON, J. V., AND WOODS, W. W. *J. Phys. Coll. Chem.*, **52**, 763–6 (*May*, 1948).—A series of experiments is described which indicates that simple mixtures of hydrocarbons are capable of foaming, although the individual hydrocarbons taken separately do not foam. Likewise, mixtures of aliphatic hydrocarbons or mixtures of aromatic hydrocarbons scarcely foam, whereas mixtures of aliphatic hydrocarbons with aromatic hydrocarbons do foam. A.

KINETIC THEORY OF LIQUIDS 532.7

532.7 : 534.2 : 536.48 *see Abstr.* 3743

532.72 3639

Diffusion across oil–water interfaces. HUTCHINSON, E. *J. Phys. Coll. Chem.*, **52**, 897–908 (*May*, 1948).—The rates of diffusion of a number of alcohols from water into benzene across the benzene–water interface have been measured. Initial rates are in the order amyl > butyl > propyl > ethyl, in qualitative agreement with the Overton–Meyer theory. The retarding effect of films of surface-active materials on the diffusion has been investigated, and measurement of the interfacial tensions of the various systems supports the hypothesis that interaction in the film is responsible for the retardation. As yet no mathematical analysis of the diffusion curves has been possible, and the results quoted are semi-quantitative. A.

532.72 : 532.133 : 541.64 3640

The intrinsic viscosities and diffusion constants of flexible macromolecules in solution. KIRKWOOD, J. G., AND RISEMAN, J. *J. Chem. Phys.*, **16**, 565–73 (*June*, 1948).—The theory is developed on the basis of the random coil model with hindered internal rotation. Proper account is taken of the hydrodynamic interaction of the monomer units of the molecule and of inhibited flow through the chain. The theory leads to results qualitatively similar to those obtained by Debye on the basis of a molecular model consisting of a sphere containing a uniform distribution of resisting points. However, significant quantitative differences between the two theories are found. A.

532.72 : 532.133 : 541.64 3641

Intrinsic viscosity, diffusion, and sedimentation rate of polymers in solution. DEBYE, P., AND BUECHE, A. M. *J. Chem. Phys.*, **16**, 573–9 (*June*, 1948).—Intrinsic viscosity, diffusion and sedimentation rate of polymers in solution is calculated by a generalization of Einstein's theory for impermeable spheres. For the coiled polymer molecule a sphere is substituted which hinders the liquid flow through its interior only to a degree depending on the average density in space of the polymer molecule in solution. The amount of shielding of the liquid flow which is introduced in this way determines the exponent in the customary exponential relation between intrinsic viscosity, diffusion, or sedimentation rate and molecular weight. This relation is shown to have only the merits of an interpolation formula. The dimensions of the mole-

cular coil can be derived from the experimental data on viscosity, and these dimensions are compared with those derived from interference measurements. The relation between intrinsic viscosity and molecular weight is rather indirect and depends essentially on the type of polymer molecule under consideration. In most cases polymer molecules are decidedly stiffer and therefore cover a larger space in solution than would be expected from models with free rotation around bonds. A.

532.72.08 : 535.417 = 3 3642

Method for measuring diffusion between liquids, using ultrasonics. KANNUNA, M. *Helv. Phys. Acta.*, **21** (*No.* 2) 93–116 (1948) *In German.*—A method is described for measuring the diffusion constant of liquids in terms of the velocity of sound in a diffusion cell by observing the diffraction patterns which are produced by transmission of monochromatic light through an ultrasonic field. In illustration, reference is made to measurements on the diffusion of methyl alcohol into water. [See also Abstr. 850 (1948)]. H. J. H. S.

532.72.096 3643

Thermal diffusion in some aqueous solutions. DOCHERTY, A. C., AND RITCHIE, M. *Proc. Roy. Soc., Edinb., A*, **62** (*Pt III*) 297–304 (1948).—Thermal diffusion in aqueous solutions of raffinose, sucrose, glucose, xylose, glycerol and acetone was studied in respect of variation of concentration and of temperature. Initial rates of separation were determined as produced by an apparatus consisting of two vertical concentric glass tubes of length 130 cm and mean annular separation 0·68 mm. With a solution of glucose of 1·7 mole/l, the initial rate of separation for the extremes of temperature which could be experimentally applied was found to be independent of the column length for lengths > 100 cm. With the exception of acetone, all the solutes concentrated at the column foot. In single-solute solutions, a maximum rate was observed at an intermediate concentration, which in the sugar series was at a lower molar concentration the higher the molar weight of the solute. With the 2-solute solutions sucrose-glucose and sucrose-glycerol, little or no relative separation was obtained, contrary to expectation based on the single-solute data. Initial rates increased with rise in mean temperature and with increase in the applied temperature gradient. A.

532.72.096 : 533.15.096 3644

An elementary treatment of thermal diffusion in gaseous and liquid systems. RITCHIE, M. *Proc. Roy. Soc., Edinb., A*, **62** (*Pt III*) 305–15 (1948).—The theory is based on the difference of diffusional characteristics of a molecule considered as diffusing through two different temperature regions, when the pressure is constant throughout. For gaseous systems, the resultant expression is shown to be in general accordance with experimental variation of temperature, mass and diameter factors, and is further developed to include isotopic separation, change of sign of separation with concentration, and general force law considerations. A similar approach to thermal diffusion in solution, combined with the convection effect of a "cascade" system, gives an expression which is in general agreement with the results of experimental variation of mean temperature and temperature gradient for aqueous solutions of sucrose, glucose and glycerol [Abstr. 3643 (1948)]. The simple expression does not account rigidly for the sign of separation or the effect of altered concentrations. These discrepancies are discussed in relation to the general formula; it is concluded that in addition to the diffusion diameters, the relative thermal expansions of solute and solvent are of importance in this connection. A.

533.15 : 531.72 364

Surface area measurements of fine powders usin modified permeability equations. CARMAN, P. C., AN ARNELL, J. C. *Canad. J. Res. A*, **26**, 128–36 (*Ma* 1948).—The several modified Kozeny equations for th measurement of the specific surface of fine powders b gas-permeability methods are compared. The equation all give very similar surface area values for a set o experimental data. The physical significance of th empirical constants used is discussed and preference i indicated. A

533.15.096 : 532.72.096 *see Abstr.* 3644

533.2 364

Pressure-volume-temperature data for oxygen. MEYERS C. H. *J. Res. Nat. Bur. Stand., Wash.*, **40**, 457–66 (*June* 1948).—To satisfy the demand for data on O_2 at highe pressures, an equation was developed that represents th available experimental data within the accuracy of th observed values. Values of the virial coefficients are given for densities in Amagat units in the temperature range $-200°$ to $+200°$C. Values of pressure in lbs/in are tabulated corresponding to temperatures from $-50°$ to $+150°$F and densities up to 320 × the density at 70°F and 1 atmos. These data are also presented in a chart, with pV/RT and pressure as co-ordinates. A

533.21 : 536.71 = 4 364

Compressibility of gases and association. DUCLAUX, J *C.R. Acad. Sci., Paris*, **226**, 1113–15 (*April* 5, 1948) *In French.*—Extensions to the author's earlier work on deviations of gases from ideality are discussed in relation to associated gases, and a formula is derived which agrees very satisfactorily with experimental data. W. R. A.

533.275 364

Divided flow, low-temperature humidity test apparatus. WEXLER, A. *J. Res. Nat. Bur. Stand., Wash.*, **40**, 479–86 (*June*, 1948).—The apparatus described produces air of known relative humidity at temperatures below 0°C with an average error of 3%. It was designed primarily for testing and calibrating at low temperature the electric-hygrometer elements used in radiosondes, although any device with a diameter less than 1·125 in may be inserted into the test chamber of the apparatus. It is capable of producing rapid and discrete changes in relative humidity at constant temperature, a desirable feature for studying lag characteristics. It is provided with a control for obtaining any air velocity up to 1 500 ft/min. A.

533.5 3649

Adjustable glass capillary gas leak. MARTIN, J. H. Note in *Rev. Sci. Instrum.*, **19**, 404–5 (*June*, 1948).

533.5 : 531.752 *see Abstr.* 3621

533.5 : 536.422.15 : 537.226.8 : 621.315.616 3650

Vacuum properties of synthetic dielectrics. HOGG, B. G., AND DUCKWORTH, H. E. *Rev. Sci. Instrum.*, **19**, 331–2 (*May*, 1948).—An experiment has been done to determine the relative vacuum properties of a number of the commercially available synthetic dielectrics. The results show wide differences in vapour pressures and indicate that certain materials are particularly well adapted for use in vacuum systems. A.

533.583 : 537.531 : 541.182.5 *see Abstr.* 4003

533.6.011 : 541.18.053 *see Abstr.* 4000

533.6.011.3 3651

Decay of turbulence in the final period. BATCHELOR, G. K., AND TOWNSEND, A. A. *Proc. Roy. Soc. A*, **194** (*No.* 1039) 527–43 (1948).—The final period of decay of a turbulent motion occurs when the effects of inertia

forces are negligible. The instantaneous velocity distribution in the turbulence field may then be found as an initial value problem. It is shown that homogeneous turbulence tends to an asymptotic statistical state which is independent of the initial conditions. In this asymptotic state the energy of turbulence is proportional to $t^{-\frac{5}{2}}$ and the longitudinal double-velocity correlation coefficient for two points distance r apart is $e^{-r^2/8\nu t}$, where t is the time of decay. The asymptotic time-interval correlation coefficient is found to be different from unity for very large time intervals only, showing the aperiodic character of the motion. The whole field of motion comes gradually to rest, smaller eddies decaying more rapidly than larger eddies, and the above stable eddy distribution is established when only the largest eddies of the original turbulence remain. Measurements were made in the field of isotropic turbulence downstream from a grid of small mesh. The energy decay and space-interval correlation relations were found to be valid at distances from the grid greater than 400 mesh-lengths and at a mesh Reynolds number of 650. The duration of the transitional period, in which the energy decay law is changing from that appropriate to the initial period of decay to the above asymptotic law, increases very rapidly with R_M. There is a brief discussion of the criterion for the existence of final period decay, although clarification must wait until the existence and termination of the initial period of decay are better understood. A.

533.6.011.5 : 534.222.2 : 535.417 *see Abstr.* 3719

533.6.08 3652

Effect of support on the performance of vane anemometers. SCHUBAUER, G. B., AND ADAMS, G. H. *J. Res. Nat. Bur. Stand., Wash.*, **40**, 275–80 (*April*, 1948).—The support is an important factor affecting the accuracy of a measurement of air speed with a vane anemometer. It is shown that seemingly minor changes in the support may change the indicated speed by 5%, and that holding an anemometer in the hand may increase the indicated speed by as much as 17%. In order to insure the reliability of a speed measurement, an interference-free type of support is recommended. A.

KINETIC THEORY OF GASES 533.7

VIBRATIONS . ACOUSTICS 534

534.01–13 = 3 3653

Theory of plane gas waves of finite amplitude. QUADE, W. *Z. angew. Math. Mech.*, **25/27**, 215–32 (*Nov.–Dec.*, 1947) *In German.*—Theory is simplified by taking as dependent variable the longitudinal displacement, as this satisfies a Monge–Ampère diff. eq. the integral of which can be given in a closed form by the method of characteristics without any integration. This applies likewise to both isothermal and adiabatic changes of state. The Riemann–Hugoniot phenomenon finds its geometrical expression in the appearance of a return edge within the integral surface of displacement. A.

534.014.5 = 4 3654

On a class of self-maintained oscillations. MINORSKY, N. *C.R. Acad. Sci., Paris*, **226**, 1122–4 (*April* 5, 1948) *In French.*—In the solution of the equation $\ddot{\theta} + p\dot{\theta} + \omega_0^2\theta + q(\lambda)\bar{\theta} = 0$, where $\bar{\theta} = \theta(t-h)$, and q is a function of a parameter λ, critical values of q exist. For any of these, $q = q_K$, the solution obtained is harmonic: for $q < q_K$ a decrement term appears: for $q > q_K$ the solution is aperiodic. If the equation is rendered non-linear by the inclusion of a small term $-q_3\bar{\theta}^3$, the corresponding solution indicates self-maintained oscillations for a small range of q in the neighbourhood of the critical value q_K. G. G.

534.121.2 = 4 3655

On the vibration spectrum of the membrane of Routh. BERÁNEK, J. *C.R. Acad. Sci., Paris*, **226**, 1244–6 (*April* 19, 1948) *In French.*—For a system of m^2 particles, connected by a network of massless cords under tension, expressions are obtained for the frequencies of vibration and for the energy connected with each frequency mode, under assumed initial conditions. By introducing the assumption that m is indefinitely increased, the modes of vibration are represented by two variables regarded as continuous: and the number of modes, $f(\nu)d\nu$, contained in any small frequency range $d\nu$, is determined by a geometrical method. Similarly the energy is expressed in terms of the same continuous variables and the total energy contained in the frequency range $d\nu$ is determined. G. G.

534.13 : 548.7 *see Abstr.* 4022

534.131 : 517.947.44 : 531.391 *see Abstr.* 3614

534.133.012 = 3 3656

Longitudinal oscillations of square quartz plates. BECHMANN, R. *Z. Phys.*, **118** (*Nos* 9–10) 515–38 (1942) *In German.*—The elastic oscillations of thin square plates cut in any position relative to the crystal axes are investigated. Calculated and experimentally determined natural frequencies for purely longitudinal oscillations agree well. For transverse oscillations a corrective term is required to make calculated and experimental values correspond. The transformations of elastic and piezoelectric coefficients of plates cut in any position with respect to the axes are given for right- and left-rotation quartz crystals, using Euler angles. V. W. R.

534.2 : 532.7 : 536.48 *see Abstr.* 3743

534.22 : 536.22 : 536.48 *see Abstr.* 3744

534.222 : 536.48 *see Abstr.* 3745

534.222.1 : 550.342 *see Abstr.* 4051

534.222.1 : 621.392.26 : 621.396.11 3657

On the theory of spherically symmetric inhomogeneous wave guides, in connection with tropospheric radio propagation and under-water acoustic propagation. BREMMER, H. *Philips Res. Rep.*, **3**, 102–20 (*April*, 1948).—[Abstr. 2815 B (1948)].

534.222.2 3658

The attenuation of spherical shock waves in air. STONER, R. G., AND BLEAKNEY, W. *J. Appl. Phys.*, **19**, 670–8 (*July*, 1948).—The peak pressure of the waves from small explosive charges was determined as a function of distance by measuring the velocity of propagation and applying the velocity-pressure relation derived from the Rankine–Hugoniot equations. The pressure-distance relations for the four principle charge types are given. The curve for spherical charges is in agreement with the Kirkwood theory, and the results for cylinders having various length/diameter ratios indicate large dependence of pressure on charge shape. A.

534.222.2 : 533.6.011.5 : 535.417 *see Abstr.* 3719

534.222.2 : 541.126 3659

The pressures exerted by an underwater explosion bubble on a circular target plate in a disc-like baffle. BRYANT, A. R. *Proc. Phys. Soc., Lond.*, **61**, 341–51 (*Oct.*, 1948).—The general equations of motion are derived for a target plate in a finite rigid baffle under the influence of pressures due to a "point source" on the axis

of the target. The fluid is assumed incompressive so that the theory should be a fair approx. in the case where the pressures are due to the oscillation of the gaseous products of an underwater explosion. The effect of the water loading on the target plate due to its own motion appears in the equation of motion as an increase in the inertia of the target. A formula for this added mass is derived for a circular target plate dishing "proportionally." The added mass is calculated for a target radius half that of the baffle in both the "piston" and "paraboloid" types of proportionally constrained motion, and it is found that it differs from the corresponding value when the baffle is infinite by not more than 15% in both cases. The pressure distribution over a rigid disc-like baffle is computed for various distances of the explosive source. Except when the source distance is small compared to the baffle radius, the pressures are considerably lower than in the case of an infinite baffle. A.

534.23 : 534.321.9 3660

Distortion of progressive ultrasonic waves. HUBBARD, J. C., FITZPATRICK, J. A., KANKOVSKY, B. T., AND THALER, W. J. Letter in *Phys. Rev.*, **74**, 107–8 (*July* 1, 1948).—Spark shadow photographs have been taken of mm sound waves in air, and a microphotometer trace is used to show the change in waveform. Preliminary results obtained with waves in water, glycerine and CCl_4, may account for the discrepancy in measured values of ultrasonic absorption. G. F. H.

534.26 3661

The diffraction of sound pulses by an infinitely long strip. FOX, E. N. *Philos. Trans. A*, **241**, 71–103 (*June* 23, 1948).—The solution is obtained for the two-dimensional diffraction problem of a perfectly-reflecting strip subjected to a plane sharp-fronted pulse of constant unit pressure at normal incidence. Numerical calculations show that the equalization of pressure round the strip "overshoots" to produce pressures on the back of the strip up to a maximum of 21% in excess of the incident unit pressure, with pressures correspondingly below incident pressure on the front of the strip. The calculations also indicate that the pressure has become effectively steady, to within 3% or less, at the incident unit pressure in a time $5b/c$ after the pulse strikes the strip, where $2b$ is the breadth of the strip and c is velocity of sound. The extension to any shape of normally incident plane pulse is given in terms of the basic solution by the principle of superposition. The formal extension of the solution to the general case of any incident two-dimensional pulse field is also given. The same general method can be applied to a number of related two-dimensional diffraction problems; and solutions and numerical results are obtained for the problems of a slit and a regular grating. A.

534.321.9 : 534.23 *see Abstr.* 3660

534.321.9 : 621.396.611.21 = 3 3662

Ultrasonic generator with standard frequency. BARONE, A. *Helv. Phys. Acta*, **21** (*No.* 2) 137–42 (1948) *In German.*—Circuit details are given of a simple precision 20 watt 4 Mc/s quartz generator comprising a 1 Mc/s quartz oscillator and a 3-stage amplifier, the last two stages serving also as frequency doublers. The frequency is controlled to an accuracy of $\pm 10^{-4}$% by comparison with the 10 Mc/s radio transmission from the National Bureau of Standards. H. J. H. S.

534.322 3663

On the performance of cup mouthpiece instruments. YOUNG, R. W. *J. Acoust. Soc. Amer.*, **20**, 345–6 (*May*, 1948).—See Abstr. 879 (1948).

534.414 : 534.845 *see Abstr.* 3664

534.845 : 534.414 366

Erratum: The application of Helmholtz resonators t sound absorbing structures. JORDAN, V. L. *J. Acous Soc. Amer.*, **20**, 344 (*May*, 1948).—See Abstr. 900 (1948

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535.14 : 539.152 *see Abstr.* 3859

535.215.2/.5 : 537.312.5 : 537.583 = 3 *see Abstr.* 3809

535.23 : 537.53 = 4 366

On the intensity of the radiation emitted by condense discharges in krypton and xenon. LAPORTE, M., LEGROS R., AND ROUX, J. *C.R. Acad. Sci., Paris*, **226**, 1265– (*April* 19, 1948) *In French.*—The effects of gas pressur and discharge capacitance and voltage were studied fo $c = 0{\cdot}5$ to 10 μfds and $v = 1\,500$–$6\,000$ V. About of the radiation measured (visible and infra-red) wa emitted in the i.r. The results are briefly summarized; n theoretical treatment is given. J. D. C

535.232 : 551.593 : 551.521 = 3 *see Abstr.* 4067

535.233 366

The proof of Wien's law. HERCUS, E. O. Letter in *Nature, Lond.*, **162**, 143–4 (*July* 28, 1948).—It is show that a spherical cavity with reflecting walls may be use in the theoretical proof without introducing any variation in the distribution of direction of the rays during adiabati expansion.

535.235 = 4 366

The variations in the spectral emissivity of oxide cathodes as a function of several factors. CHAMPEIX, R *C.R. Acad. Sci., Paris*, **226**, 1256–7 (*April* 19, 1948) *In French.*—The emissivity was obtained from the re flectivity. The variations with temperature, coating thickness and activation are given. A mean figure 0·2 would be tolerable, but values between 0·1 and 0·3 are common. A. H. W. B.

535.24 : 535.88 = 4 *see Abstr.* 3728

535.24 : 621.383 = 4 3668

Local variations of sensitivity in photoelectric cells. LAYCOCK, N., AND WINCH, G. T. *C.R. Acad. Sci., Paris*, **226**, 1445 (*May* 3, 1948) *In French.*—[Abstr. 2770 B (1948)].

535.242 3669

An investigation of the Macbeth illuminometer. MIDDLETON, W. E. K., AND RAMSEY, A. R. *Canad. J. Res. F*, **26**, 59–65 (*Feb.*, 1948).—This is a well-known portable photometer of the visual type. Measurements of its errors show that the instrument gives reliable results if used with care. The most serious errors may occur when the colour temperature of the light that is being measured differs greatly from that of the working standard lamp in the instrument. Under such conditions, different observers may obtain widely different results. A.

535.243 : 535.372.08 *see Abstr.* 3706

535.247.4 3670

Calibration of a photo-multiplier photometer. DEVORE, J. R. *J. Opt. Soc. Amer.*, **38**, 692–6 (*Aug.*, 1948).—The photometer was constructed for the measurement of brightness of luminescent materials. It was calibrated so that the brightness values correlate with direct visual observations. The calibration curves are presented and are shown to be in agreement with published eye-sensitivity data. A.

535.317.1 3671

Image error theory for finite aperture and field. I. The image of a point; geometry of the wave surface. HERZBERGER, M. *J. Opt. Soc. Amer.*, **38**, 736–8 (*Aug.*,

1948).—The usual image error theory is replaced by a new one which permits the analysis of the symmetry qualities of the image by means of a few diagrams. Three new functions are introduced: the deformation function, D, the asymmetry function, A, and the spherical aberration function, S. The distance, τ, of the caustic from the diapoints is given by $\tau^2 + S\tau + D\zeta^2 = 0$, and $D = S = 0$ gives a system free from aberration. S, D, and A are developed as functions of a special kind of variable, $\eta - \eta_0, \zeta - \zeta_0$. Here, ζ and η are the direction cosines of the image ray with the optical axis and the perpendicular to it in the meridian plane; ζ_0 and η_0 are the corresponding angles for the principal ray of the bundle to be investigated. Formulae are given for the development of these functions and for their connection with the characteristic function of the system. A.

535.317.2 3672

Paraxial differential transfer coefficients of a lens system. DREYFUS, M. G. *J. Opt. Soc. Amer.*, **38**, 703–5 (*Aug.*, 1948).—A shorter method is given for computing $C(u_i')$ and $C(y_i)$ for paraxial rays than that described by Cruickshank [Abstr. 1285 (1946)], and a calculation plan is given for computing the rate of change of position of an axial ray in the image space v. change in curvatures, indices of refraction, and separations of lens elements. A.

535.317.3 3673

Reduction of sphero-chromatic aberration in catadioptric systems. STEPHENS, R. E. *J. Res. Nat. Bur. Stand., Wash.*, **40**, 467–9 (*June*, 1948). Also in *J. Opt. Soc. Amer.*, **38**, 733–5 (*Aug.*, 1948).—Schmidt and Maksutov catadioptric systems suffer from sphero-chromatic aberrations that are of opposite sign. By the use of a hybrid system, whose corrector is a deep-meniscus lens with an aspheric curve on the external surface, the sphero-chromatic residuals were reduced and, as a consequence, usable relative apertures have been increased. A.

535.324–31 3674

The refractive index of several hydrocarbons in the near ultraviolet wave-length region. LAUER, J. L. *J. Chem. Phys.*, **16**, 612–19 (*June*, 1948).—Index of refraction measurements were carried out with 21 liquid hydrocarbons, paraffinic, naphthenic, olefinic and aromatic, in their respective transparent regions between 220 and 420 millimicrons, both at 20° and 25°C, to an average accuracy and precision of $\pm 0{\cdot}0002$ in refractive index. The data for each compound were fitted to an empirical equation relating frequency and index, and from these the constants in the Sellmeier–Drude equation were calculated wherever possible. Interesting variations in these constants were observed for compounds of related structures. The instrument used for the measurements was the same as the one described in an earlier article [Abstr. 3112 (1947)]. A.

535.327 : 666.1 3675

Changes in the indices of refraction and liquidus of a barium crown glass produced by the partial substitution of some oxides. HAMILTON, E. H., GRAUER, O. H., ZABAWSKY, Z., AND HAHNER, C. H. *J. Res. Nat. Bur. Stand., Wash.*, **40**, 361–74 (*May*, 1948).—Optical glasses with high indices of refraction and Abbe values are very desirable for wide-angle lenses. In order to determine the range of compositions in which glasses of this type could be produced, oxides of Li, Be, Ca, B, La, or Th were substituted for BaO or SiO_2 in a three- or four-component base glass. Substitutions were made on a mole-for-mole basis. The indices of refraction for the C, D, F and G' lines and the liquidus were determined for each glass. Experimental glasses with indices of refraction and Abbe values from 1·600 to 1·714 and 62·2 to 52·7, respectively, were made in small Pt crucibles. A.

535.331 3676

Multiplet separations in complex spectra (of d^3 and d^4 configurations). RAMAKRISHNA RAO, V., AND RAO, K. R. *Indian J. Phys.*, **22**, 175–9 (*April*, 1948).—Expressions for multiplet separations derived by Goudsmit for complex spectra arising out of equivalent electron configuration were applied to the spectra of V and Nb (Cb), which have been recently analysed extensively on the basis of Zeeman effect and hyperfine structure studies. The check between theoretical and experimental values indicates a correspondence chiefly in the case of the deeper terms. The disagreement in Nb II is exceptionally large. A.

535.331 3677

Multiplet separations in complex spectra. II. RAMAKRISHNA RAO, V., AND RAO, K. R. *Indian J. Phys.*, **22**, 189–94 (*April*, 1948).—Expressions, derived by Goudsmit and Humphreys for multiplet separations in complex spectra, are applied to the observed multiplets of d^3s and d^3p configurations in Zr I, Nb II and Ti I, V II and Cr III. A comparison between the theoretical and the experimental values of the separation factors indicates agreement in the deeper terms and chiefly of the d^3s configuration. The method is expected to give only the order of magnitude of the separations when it is used for the purpose of predicting unknown structures. A.

535.331 3678

The first spectrum of copper (Cu I). SHENSTONE, A. G. *Philos. Trans. A*, **241**, 297–322 (*Aug.* 10, 1948).—An analysis is made. All predictable types of electron structure are identified. The spectrum is unique in having many more identified levels above the point of easiest ionization than below. Auto-ionization is the rule rather than the exception. Many series converge to complex limits and show various degrees of perturbation. The peculiar behaviour of some groups of series is described in detail. A.

535.332 : 530.145.61/.62 : 539.152.1 = 3 *see Abstr.* 3863

535.337 : 535.35 = 82 *see Abstr.* 3700

535.338.1 3679

Afterglow of the Balmer spectrum of hydrogen. HERMAN, R., AND HERMAN, L. Letter in *Nature, Lond.*, **162**, 261 (*Aug.* 14, 1948).—In the case of certain electrical discharges in He/H_2 it is shown that a strong H afterglow exists after current flow has ceased, and that this afterglow is attributable to radiative electron/ion recombination. The afterglow (Balmer lines and continuum) is weak unless He or Ne is added to the H_2. J. D. C.

535.338.1 : 539.153 : 551.594.51 3680

On the emission of the forbidden lines from the metastable ground states $^1S_0$ and $^1D_2$ of the neutral oxygen atom. KVIFTE, G., AND VEGARD, L. *Geofys. Publ.*, **17** (*No.* 1) 3–34 (1947) *In English.*—Spectrograms of the auroral OI lines, from the forbidden transitions ($^1D_2$–$^1S_0$), ($^3P_{2,1}$–$^1D_2$) have been photographed in the laboratory, using pure O_2 and O_2–Ne mixtures in the discharge tube. Current varied between 25 and 230 mA; total pressure, 1·5 to 50 mm Hg; O_2 concentration, 1·5 to 100%. Accurate wavelengths of the three lines were measured at 5 577·346, 6 300·297 and 6 363·854 Å. Relative intensities of the red lines gave for the ratio, I_{6364}/I_{6360}, the value 0·33 in agreement with theory. For pure O, the number of OI atoms per unit volume brought to the metastable state was found to $\propto$ those brought to the normal excited state. Comparison between theory and experiment leads to a probability value for the disturbance of the metastable ($^1S_0$) state by collision of

O atoms with either O_2 molecules, or Ne atoms. In O_2, 3–4 per 10^6 collisions disturb the metastable state, whilst in Ne only 2–3 per 10^7 are effective: for the normal excited state much higher values are found, around 0·01 for Ne, and 1·0 for O_2. Thus the stable excited states of O atoms appear much more sensitive to collision with O_2 molecules or Ne atoms than do the meta-states. This result may have important bearing on cosmical light sources emitting "forbidden" radiation. D. R. B.

535.338.1–15 : 536.46 3681

Infrared emission spectra of flames. Plyler, E. K., and Humphreys, C. J. *J. Res. Nat. Bur. Stand., Wash.*, **40**, 449–56 (*June*, 1948).—The spectra of an H flame and of a natural gas flame were compared in the region from 1·7 μ to 24 μ. Emission bands were observed at 1·87 μ, 2·78 μ, 4·37 μ, 6·26 μ and 15 μ that are produced by molecules of H_2O and CO_2. Another band at 3·316 μ is attributed to methane. From 3·0 μ to 3·8 μ there are a number of rotational lines, some of which may be produced by OH and others by H_2O molecules. As the temperature of the flame was increased, the rotational lines became more intense. Five lines in the region from 3·4 μ to 3·8 μ agree closely in position with the predicted rotational lines of the *P* branch of the $2 \rightarrow 1$ vibrational band of OH. These lines correspond to values of *K* equal to 11, 12, 13, 14 and 15. Wave numbers of some of the observed rotational lines were found to show a good correspondence with predicted values for *K* equal to 11 to 36, for lines extending from 9 μ to 24 μ. In addition to this series of lines, there are other lines that are produced by the rotational states of H_2O molecules. A discussion is included of the various methods of observing flame spectra. A.

535.338.332 : 539.153 3682

The *S*-level shift in ionized helium. Fowles, G. R. Letter in *Phys. Rev.*, **74**, 219–20 (*July* 15, 1948).—Improved measurements of the structure of the line at 1 640 Å are reported [see Abstr. 2072 (1948)]. The new value of the shift of the 2*S* level is $0{\cdot}44, \pm 0{\cdot}05_0$ cm^{-1}, in good agreement with calculation. R. F. B.

535.338.4 3683

Emission Schumann–Runge O_2 bands. Feast, M. W. Letter in *Nature, Lond.*, **162**, 214–15 (*Aug.* 7, 1948).—The system has been photographed from 2 000 to 5 000 Å, using a large Littrow spectrograph. Additional to bands reported earlier by other workers, 17 new bands have been detected. The results show discrepancies with those of Lalji Lal, using a h.f. discharge [Abstr. 2073 (1948)], due partly to inadequate dispersion in the latter instance, and partly to differences in the excitation. Analysis confirms the incorrectness of Flory's predissociation theory for $v' > 2$. The bands are very sensitive to pressure, emission being strong only at pressures near atmospheric for normally purified gas. Under these conditions, recombination of dissociated O_2 molecules to the excited state will be favoured by the absence of rapid diffusion. D. R. B.

535.338.4 : 539.17 : 539.155.2 3684

Nuclear spins of the carbon isotopes. Jenkins, F. A. *Phys. Rev.*, **74**, 355–63 (*Aug.* 15, 1948).—High dispersion spectrograms of the Swan bands of diatomic carbon were obtained from samples enriched to 50% and 40%, respectively, in C^{13} and C^{14}. The method of exciting an intense spectrum with microgram samples is described. To permit measurements of the alternating-intensity ratio, current densities in the source had to be limited so that the Λ-type doublets were well resolved. For C^{13}, photometric measurements of this ratio give 3 : 1, showing that the nuclear spin $I = \frac{1}{2}$. The antisymmetr rotational levels have higher statistical weight (Ferm Dirac statistics). For C^{14}, only the lines from symmetr levels appear. This shows clearly that $I = 0$ for C^1 and that the nucleus obeys Einstein–Bose statistic Wave numbers are given of lines in the *R* branches of th 0,0 band in the range $K = 12$ to 20, due to all molecula species containing C^{12}, C^{13} and C^{14}. An isotope effec in the splittings of the electronic triplets is investigate and found to agree with that calculated from the genera term formula for $^3\Pi$ states. A

535.338.41 368

The *B–N* band-system of silver iodide. Barrow, R. F and Mulcahy, M. F. R. *Proc. Phys. Soc., Lond.*, **61** 99–100 (*July*, 1948).—The results of measurements of th band-head for $Ag^{107}I$ are presented, and new informa tion about the vibrational levels of the excited state ar obtained. These are compared with those of Bric [Abstr. 114 (1932)]. L. S. G

535.34 : 541.27 : 537.531 = 4 *see Abstr.* 3783

535.341 = 4 368

Absorption spectra of HBr and HI in the Schuman region. Romand, J., and Vodar, B. *C.R. Acad. Sci. Paris*, **226**, 890–2 (*March* 15, 1948) *In French.*—Curve of the extinction coefficients, κ, of HBr and HI, in the gas phase, with wave-number, are given. The maximum value of κ ($= d^{-1} \log_{10} I_0/I$, with *d* in cm for 0°c and 760 mm) is 23·5 at 56 000 cm^{-1} for HBr and 7·8 a 46 000 cm^{-1} for HI. [See Abstr. 2083 (1948)]. R. F. B

535.341 = 4 3687

A new method for the measurement of the two parameters of an absorbing medium. Arzelies, H. *C.R. Acad Sci., Paris*, **226**, 1080–1 (*March* 31, 1948) *In French.*—This method is based on the study of the reflected intensity at various angles of incidence. L. P.

535.343 3688

Excited states of silver bromide and iodide. Barrow, R. F., and Mulcahy, M. F. R. Letter in *Nature, Lond.*, **162**, 336–7 (*Aug.* 28, 1948).—The vibrational analysis of an absorption band system attributed to AgBr vapour is reported. The constants of the upper level are: $\nu_e = 43\,537$, $\omega_e = 205{\cdot}0$, $x_e\omega_e = 0{\cdot}74$ cm^{-1} (for $Ag^{109}Br$). Analyses of two ultra-violet systems of Ag I are in agreement with earlier work [Abstr. 2100 (1939)]. R. F. B.

535.343 = 3 3689

The spectrum of primary alcohols between 14 000 and 9 000 cm^{-1}. Kreuzer, J. *Z. Phys.*, **118**, 325–39 (1941) *In German.*—The spectrum of primary alcohols is photoelectrically measured using infra-red light up to 1·1 μ; and compared with substances showing clear OH or CH spectra. Natural frequencies obscured by multiple lines are determined by the variation of refractive index. The shift of CH frequencies by coupling is small and the observed splitting is due mainly to constitution differences of various CH_2 and CH_3 groups. The law of proportionality of integral absorption is obeyed. Dilution with carbon tetrachloride does not alter the absorption maxima of CH lines. V. W. R.

535.343–14 : 539.132 *see Abstr.* 3851

535.343.4 3690

Violet asymmetry of potassium resonance lines under high rubidium vapor pressures. Ch'en, S.-Y. Letter in *Phys. Rev.*, **73**, 1470 (*June* 15, 1948).—Absorption tubes for alkali vapours at high pressure were constructed with corrosion-resistant MgO windows. Some results are given for a tube filled with Rb with a trace of K. L. P.

535.343.4–14 : 538.615 3691

Saturation effects in microwave spectroscopy. KARPLUS, R. Letter in *Phys. Rev.*, **74**, 223–4 (*July* 15, 1948).—Theory and experiment of several workers are compared, and it is confirmed that the Zeeman components of the 3,3 line of the NH_3 inversion spectrum saturate separately at high powers. D. H. W.

535.343.4–14 : 539.132 3692

On the fine structure in the inversion spectrum of ammonia. HENDERSON, R. S. Letter in *Phys. Rev.*, **74**, 107 (*July* 1); errata, 626 (*Sept.* 1, 1948).—Accounts for discrepancies [Abstr. 2420 (1948)] in the inversion spectrum of NH_3 by means of coupling between the nuclear dipole moment and the magnetic field set up by molecular rotation. D. H. W.

535.343.4–14 : 539.133 *see Abstr.* 3853

535.343.4–14 : 539.152.2 3693

Rotational spectrum of $OC^{14}S$, and the nuclear spin of C^{14}. ROBERTS, A. Letter in *Phys. Rev.*, **73**, 1405 (*June* 1, 1948).—Observations of $J = 1 \rightarrow 2$ transition of $OC^{14}S$ at $24\,173{\cdot}0 \pm 1$ Mc/s, its Stark effect pattern and lines due to excited states. All agree with accepted parameters except the separation of the *l*-type doublet: the absence of quadrupole effects requires the spin of C^{14} to be zero. Difficulties arising in the interpretation of the β-ray transition $C^{14} \rightarrow N^{14}$ are discussed. D. H. W.

535.343.4–31 = 4 3694

Ultra-violet absorption spectrum of camphor vapour. PARIAUD, J.-C., AND RICARD, R. *C.R. Acad. Sci., Paris*, **226**, 886–8 (*March* 15, 1948) *In French.*—The effect of alcohol on the absorption bands of camphor indicates interaction between the two molecules. R. F. B.

535.343.4–31 3695

Erratum: Ultraviolet absorption spectrum of hydrogen peroxide. HOLT, R. B., MCLANE, C. K., AND OLDENBERG, O. *J. Chem. Phys.*, **16**, 638 (*June*, 1948).—See Abstr. 1812 (1948).

535.343.9 : 541.65 = 82 3696

Dependence of the optical absorption frequency of *p*-polyphenyls on the number of phenyl groups. DAVIDOV, A. S. *J. Exp. Theor. Phys.*, **18**, 515–18 (*June*, 1948) *In Russian.*—A theory is given of the dependence of the frequency and intensity of light absorbed by *p*-polyphenyls on the length of the chain of the polymer. The theory is in good agreement with experimental data. A.

535.345 3697

A photometric investigation of dust. SPENCER, D. E., AND MALKIEL, S. *J. Franklin Inst.*, **245**, 389–402 (*May*, 1948).—The paper presents data on the transmittance of dust films, as a function of time and angle. These results may be summarized by the equation $\tau = \delta + (1 - \delta)\varepsilon^{-0{\cdot}00740t}$, where $\delta = 0{\cdot}634 + 0{\cdot}047\varepsilon^{1{\cdot}253\theta}$ if $0 \leq \theta \leq \pi/2$, $\delta = \delta(\pi/2)$ if $\pi/2 \leq \theta \leq \pi$, and $\tau =$ transmittance of a single dust film, $t =$ time, days, and $\theta =$ angle between the normal to the dust-collecting surface and the upward direction (radian). These results were applied to the prediction of the effect of dust on the performance of various types of luminaires using fluorescent and incandescent lamps. A.

535.345.1 : 666 3698

A study of some special u.v.-absorbing glasses which are transparent to visible radiation. ČTYROKÝ, V. *J. Soc. Glass Tech.*, **32**, 40–5 (*Feb.*, 1948).

535.345.6 : 535.41 *see Abstr.* 3717

535.347–15 : 541.57 3699

Near infra-red absorption of nylon films: dichroism and rupture of N–H . . . O bonds on melting. GLATT, L., AND ELLIS, J. W. Letter in *J. Chem. Phys.*, **16**, 551 (*May*, 1948).—Bands from 4 000–7 000 cm^{-1} are divided according as their electric moment change is $\parallel$ or $\perp$ to the nylon chain axis and possible assignments are discussed. The chain-linking N–H . . . O bonds break above 260°C to form free N–H groups. D. H. W.

535.35 : 535.337 = 82 3700

Mechanism of excitation of spectral lines in the high-temperature vacuum furnace. FRISCH, S. E., PENKIN, N. P., AND SHUKHTIN, A. M. *J. Exp. Theor. Phys.*, **18**, 734–6 (*Aug.*, 1948) *In Russian.*—It is shown by the method of conversion of the spectral lines that in the high-temperature vacuum furnace the distribution of atoms on the levels of excitation is the equilibrium distribution. The corresponding temperature coincides, within the limits of experimental error, with the temperature of the furnace walls, and this demonstrates the pure temperature character of the excitation of the spectral lines in the vacuum furnace. A.

535.352 3701

Excitation processes in molecular nitrogen. NICHOLLS, R. W. *Nature, Lond.*, **162**, 231–2 (*Aug.* 7, 1948).—Difficulties in reconciling the results of electron impact measurements with the analysis of the Vegard–Kaplan bands $A^3\Sigma_u^+ \rightarrow X^1\Sigma_g^+$ can be overcome if it is assumed that the primary result of collisions of ground-state N_2 with electrons is to populate the singlet levels $a^1\Pi$ and *b*. Population of the triplet levels may subsequently be brought about by 2nd-kind collisions between excited singlet molecules and slow electrons. R. F. B.

535.354 = 4 3702

Long duration of the Balmer spectrum of hydrogen. HERMAN, R. *C.R. Acad. Sci., Paris*, **226**, 888–90 (*March* 15, 1948) *In French.*—Experiments suggest that the apparent life-time of excited H atoms found by Rayleigh [Abstr. 2604 (1944)] was lengthened by recombination $H^+ +$ electron. R. F. B.

535.37 : 535.41 : 548.73 *see Abstr.* 4031

535.37 : 536.48 : 77.535 = 4 *see Abstr.* 4084

535.37 : 537.312.5 : 548.0 = 3 3703

On the optical and electrical properties of cadmium sulphide. FASSBENDER, J. *Naturwiss.*, **34** (*No.* 7) 212–13 (1947) *In German.*—Single crystals of CdS are usually red or green, occasionally of mixed colour, and fluoresce under sufficiently intense excitation. Spectral analysis shows a narrow green band (about 5 200 Å) and a wide red band (600 Å to end of visible region). The green fluorescence is partly polarized. The crystals are photoconductive for wavelengths corresponding to the two emission regions. The conductivity (σ) and the intensity of illumination (ϕ) are related by an expression of the form $\sigma = C(\lambda) \cdot \phi^{\alpha}$ where α is a constant (between 0·7 and 0·95) and $C(\lambda)$ a function of wavelength only. The quantum efficiency of the photo-conductivity is very high, which may give rise to many new applications. H. K. H.

535.371 = 4 3704

On the growth of the photoluminescence of zinc sulphide under constant excitation. SADDY, J. *C.R. Acad. Sci., Paris*, **226**, 896–8 (*March* 15, 1948) *In French.*—The measured growth of luminescence of ZnS . Cu agrees well with a simple exponential function, but any theoretical treatment leads to more complex formulae. S. T. H.

535.372 3705

Cathodo-luminescence spectra of Indian fluorites. MUKHERJEE, B. *Indian J. Phys.*, **22**, 220–8 (*May*, 1948).—The spectra of some chemically decomposed specimens of

Indian fluorite in the visible and in the u.v. region were studied using a direct-vision spectrograph and a Fuess quartz spectrograph. For the examination of rare earths in fluorites, when they were converted into oxides, the luminescence exhibited was so bright that an exposure of 5–10 min was quite sufficient for taking a spectrogram. On inspection of the line-like bands in the luminescence spectra, it was ascertained that the activators for luminescence of decomposed specimens were Sm, Dy, Eu, Er, Nd, Gd and Tb. The rare earths with even atomic number were the chief activators for luminescence with the exception of Eu of odd atomic number. For the strong activating ability of the above rare earths, the presence of Pr could not be ascertained definitely. In all specimens Sm acted as the chief activator for luminescence. It was concluded that, though Mn was present in all the specimens, the characteristic Mn-band in the visible region was suppressed in the luminescence spectra by the strong activating action of rare earths, when present in optimum quantity for strong activating ability. The natural colour of fluorite was in no way connected with the varieties of rare earths contained in it. A.

535.372 : 537.531 *see Abstr.* 3784

535.372.08 : 535.243 3706

Measurement of fluorescence spectra. SAMBURSKY, S., AND WOLFSOHN, G. Letter in *J. Opt. Soc. Amer.*, **38**, 379 (*Aug.*, 1948).—See Abstr. 2822 (1947). An additional precaution needed in taking measurements is pointed out.

535.375 : 548.0 = 82 3707

Luminescence and energy level distribution in photochemically coloured alkali-halide crystals. KATZ, M. L. *J. Exp. Theor. Phys.*, **18**, 501–9 (*June*, 1948) *In Russian.*—The distribution of localization levels of energy was investigated in NaCl, KCl, and KBr crystals at low temperature by taking the curves of their thermo-luminescence in the u.v. and visible parts of the spectrum. From these curves the values of the energy of activation were calculated, i.e. the depths of occurrence of localization levels of energy relative to the zone of conductivity and to the upper zone of occupied energy levels, respectively. The mechanism of the thermo-luminescence of the crystals in the u.v. and visible parts of the spectrum is discussed. A.

535.375.5 3708

On the Raman spectra of a few nitriles at low temperatures. BISHUI, B. M. *Indian J. Phys.*, **22**, 167–74 (*April*, 1948).

535.375.5 3709

An extension of the polarizability theory of Raman effect. MATOSSI, F., AND MAYER, R. *Phys. Rev.*, **74**, 449–55 (*Aug.* 15, 1948).—The theory has 2 defects: (1) The depolarization factor ρ of Raman lines of totally symmetric oscillations of molecules can be given only by the indefinite statement $\rho < 6/7$; additional utilization of the Silberstein model of optical anisotropy for a more precise prediction leads to wrong results. (2) The depolarization factor of the totally symmetric lines of calcite and aragonite should be zero for every orientation of the crystals, whereas finite values are observed for some orientations. An extension is proposed. It is assumed that the atomic polarizability α is dependent on the exciting field strength E ($\alpha = \alpha_0 + \beta E^2$). In the crystals, it is furthermore assumed that a disturbing field exists which depends on crystal symmetry. With these assumptions, it is possible to account for the observed results without changing the fundamentals of the polarizability theory. A.

535.375.5 : 548.7 *see Abstr.* 4023

535.375.5 : 548.7 = 4 371

Internal oscillations of the SO_4 ion in a crystal of Epsom salts. BOUHET, C., AND LAFONT, R. *C.R. Acad. Sci. Paris*, **226**, 1263–5 (*April* 19, 1948) *In French.*—The SO_4 ion in epsom salts has the symmetry C_1. The intensities of the Raman lines are calculated in first approximation by assuming that the variations in polarizability are the same as for the ion in the free state; the lowering of the symmetry of the ion is then taken into account by giving small values to constants which for the free ion should be zero. The Raman effect has been observed for this crystal and is reported, and the observed relative intensities and the depolarizations of the lines are listed. Except for the absence of some weak lines, the results are in agreement with expectation. A. C. M.

535.375.5 : 548.7 = 4 3711

Raman spectrum and structure of ammonium chloride. COUTURE, L., AND MATHIEU, J.-P. *C.R. Acad. Sci. Paris*, **226**, 1261–3 (*April* 19, 1948) *In French.*—Polarization studies of the Raman spectrum of a single crystal of NH_4Cl at room temperature allow the lines to be classified into those of singlet, doublet and triplet types respectively. The classification obtained is consistent with the symmetry C_{3v} of the NH_4^+ ion, which could come about through a rotation of the ion about a ternary axis. A. C. M.

535.375.5 : 548.7 = 5 3712

Origin of the low frequency Raman spectrum of calcite. GIULOTTO, L., AND OLIVELLI, G. *Nuovo Cim.*, **5**, 52–7 (*April*, 1948) *In Italian.*—2 537 Å light is directed along the optic axis of a single crystal of calcite, and the Raman radiation is observed perpendicularly. While the internal frequencies 1 088 and 1 437 cm^{-1} are found to be polarized with electric vector perpendicular to the optic axis; the two external frequencies, 155 and 282 cm^{-1}, are parallel. This shows that the two external frequencies belong to angular oscillations of the CO_3 ion round axes perpendicular to the optic axis, and the activity in the Raman effect is only explicable if they are coherent and in phase. The structure of the calcite crystal is such that translatory vibrations of the Ca and CO_3 ions across the optic axis induces a turning moment in the same sense in all the CO_3 ions. This translatory vibration is coupled with the rotational oscillation, giving rise to two frequencies. They should also be active in the infra-red spectrum. [Also appears as letter in *J. Chem. Phys.*, **16**, 555–6 (*May*, 1948). Diagram printed in error on p. 552.] A. C. M.

535.376 = 3 3713

On the action of α-radiation on the growth of luminescence of a ZnS . Cu phosphor. BANDOW, F. *Z. Naturforsch.*, **3a**, 16–20 (*Jan.*, 1948) *In German.*—Light sum measurements were made after excitation in order to define a constant for the growth of luminescence during excitation. A phosphor previously bombarded with α-radiation showed a greatly retarded build-up, depending on the state of excitation of the centres of slow decay. S. T. H.

535.376 : 539.16.08 = 3 3714

On the elementary process of light excitation in phosphors by α-particles, fast electrons and γ-quanta. II. BROSER, I., AND KALLMANN, H. *Z. Naturforsch.*, **2a**, 642–50 (*Nov.–Dec.*, 1947) *In German.*—Continuing former work [Abstr. 729 (1948)], the luminescence of various phosphors has been measured by an electron multiplier system which permits the detection of single α-particle scintillations in ZnS, or, with the multiplier cooled to reduce dark current, of single light pulses in naphthalene produced by electrons of 1 MeV, or by

γ-rays. Typical oscillograms are reproduced. Effects of screen thickness and light absorption are discussed, also the varied response of phosphors to different exciting agents, and the possibility of neutron detection. S. T. H.

535.376 : 539.16.08 = 3 3715

On the elementary process of light excitation of phosphors. III. The excitation of naphthalene (further experiments with the phosphor counter). BROSER, I., HERFORTH, L., KALLMANN, H., AND MARTIUS, U. M. *Z. Naturforsch.*, **3a**, 6–15 (*Jan.*, 1948) *In German.*—Previous work is continued [Abstr. 3714 (1948)]. Naphthalene fluoresces in the near ultra-violet, especially to β-, γ- and hard X-rays, but poorly to slow electrons and α-rays. Comparative results are given for ZnS. A thick layer of naphthalene (1 g/cm²) was used as a counter for γ-quanta and cosmic rays by detection of the light flashes produced: the sensitivity compared favourably with that of a Geiger–Müller counter. S. T. H.

535.393 : 530.145 = 4 3716

Quantum theory of the optical properties of metals. HERPIN, A. *Rev. Sci., Paris*, **85**, 1063–74 (*Nov.* 1 *and* 15, 1947) *In French.*—An up-to-date review of the subject. L. P.

535.41 : 535.345.6 3717

Errata: Reflection and transmission interference filters. I. Theory. HADLEY, L. N., AND DENNISON, D. M. *J. Opt. Soc. Amer.*, **38**, 546 (*June*, 1948).—See Abstr. 2519 (1947).

535.41 : 535.37 : 548.73 *see Abstr.* 4031

535.412 3718

Irradiance distribution in a Lloyd mirror interference pattern. WOLFE, R. N., AND EISEN, F. C. *J. Opt. Soc. Amer.*, **38**, 706–11 (*Aug.*, 1948).—The pattern reappears and disappears in a periodic manner at distances from the mirror edge greater than the distance to the initial point of disappearance. In certain cases bright lines appear where dark lines should appear. A photograph of such a pattern is shown, measured values of the relative irradiance as a function of distance from the mirror edge are presented, and a theoretical determination which accounts for certain features of this variation of irradiance with distance is outlined. A.

535.417 : 532.72.08 = 3 *see Abstr.* 3642

535.417 : 533.6.011.5 : 534.222.2 3719

The Mach interferometer applied to studying an axially symmetric supersonic air jet. WINCKLER, J. *Rev. Sci. Instrum.*, **19**, 307–22 (*May*, 1948).—The method of adjustment, measurement, and evaluation of interferograms, calculation of densities, and typical results are given. A satisfactory light source embodying speed, monochromacy, and brilliance has been found. The resolution, accuracy, and sensitivity are discussed, and photographs illustrating many features of the instrument are presented. The method of analysis is not limited to air jets but is generally applicable to all axially symmetric air streams. A.

535.42 : 537.531 : 539.163.2 *see Abstr.* 3898

535.42 : 548.73/.74 *see Abstr.* 4032

535.55 : 539.4.016 : 666.1.037.5 *see Abstr.* 4083

535.55 : 548.0 3720

Photoelastic properties of cubic crystals. BURSTEIN, E., AND SMITH, P. L. Letter in *Phys. Rev.*, **74**, 229–30 (*July* 15, 1948).—Recent photo-elastic data on cubic crystals are discussed which show that Mueller's conclusions concerning the optical anisotropy contribution must be modified [see Abstr. 3295 (1935)]. His predictions for crystals having NaCl structures are correct, but those for diamond and CsCl structures are wrong. The use of the optical anisotropy constant λ_0 as a measure of the amount of homopolar bonding is mentioned, together with some qualitative relations between λ_0 and the temperature-dependence of the refractive index. [See also Abstr. 2479 (1947), 109 (1948)]. H. G. J.

535.551 : 548.0 3721

Technical crystals with abnormally large stress birefringence. WEST, C. D., AND MAKAS, A. S. Letter in *J. Chem. Phys.*, **16**, 427 (*April*, 1948).—Stress birefringence constants are given for crystals of MgO, LiF, KBr, AgCl, Tl(Cl, Br), Tl(Br, I), ZnS and diamond. The Tl(Br, I) crystal exhibits the highest C and π constants of any crystal so far reported, and has negative values for C_1 and C_3. The stress-optical constant of ZnS is apparently the largest recorded. [See Abstr. 2120 (1947)]. H. G. J.

535.62 3722

I.C.I. specifications of difference limens for Munsell hue, value, and chroma. BRENNAN, J. G., AND NEWHALL, S. M. *J. Opt. Soc. Amer.*, **38**, 696–702 (*Aug.*, 1948).—Colour difference limens of three observers were determined separately for each of the Munsell analogues of hue, saturation, and lightness at each of a number of locations in the surface-colour solid. The data is presented in terms of the standard I.C.I. system. In addition to detailed tabulations of the x, y, and Y specifications, the means of the chromatic difference limens of the three observers are plotted in the I.C.I. chromaticity coordinates at three levels of reflectance. Absolute chroma limens for Munsell red, yellow, green, blue, and purple are tabulated at 7 levels of reflectance. In terms of distances in the chromaticity diagram, the general mean hue and chroma limens were, respectively, 0·0023 and 0·0035; and the mean Fechner fraction from the value data is 0·0087. A.

535.767 3723

Distortion of stereoscopic spatial localization. OGLE, K. N., AND BOEDER, P. *J. Opt. Soc. Amer.*, **38**, 723–33 (*Aug.*, 1948).—The apparent distortion of stereoscopic space perception, caused by unequal magnifications of the images of the two eyes, is studied from a mathematical point of view. It is shown that, at least qualitatively, the spatial distortions can be predicted on a geometric basis. A.

535.8 3724

A new calculus for the treatment of optical systems. VII. Properties of the N-matrices. JONES, R. C. *J. Opt. Soc. Amer.*, **38**, 671–85 (*Aug.*, 1948).—Preceding papers [Abstr. 1848 (1947)] examined the properties of an optical calculus which represented each of the separate elements of an optical system by means of a single matrix M. This paper is concerned with the properties of matrices, denoted by N, which refer not to the complete element, but only to a given infinitesimal path length within the element. If M is the matrix of the optical element up to the point z, where z is measured along the light path, then the N-matrix at the point z is defined by $\mathrm{N} \equiv (d\mathrm{M}/dz)\mathrm{M}^{-1}$. The general properties of N-matrices are developed and the important special case in which the optical medium is homogeneous, so that N is independent of z is discussed. A systematic method, based on the N-matrices, by which the optical properties of the system at each point may be described uniquely and quantitatively as a combination of a certain amount of linear birefringence, a certain amount of circular dichroism, etc., is described. The properties of the inhomogeneous crystal which is obtained by twisting a homogeneous crystal about an axis parallel to the light path are studied. A.

535.8 : 612.844 *see Abstr.* 4082

535.822 3725

The multipupil in phase microscopy. OSTERBERG, H. *J. Opt. Soc. Amer.*, **38**, 685–8 (*Aug.*, 1948).—Auxiliary lenses may be employed in a modified phase microscope to form additional images of the condenser diaphragm. These images are called multipupils. They can serve to increase the flexibility of the phase microscope because a diffraction plate may be placed at any one or at all of the multipupils. Multipupil systems serve as effective means for phase microscopy. The bipupil system is of most practical interest because it combines the required flexibility with simplicity. It is shown on general theoretical grounds that the multipupil system is equivalent to a single system of phase microscopy whose over-all magnification is equal to the product of the magnifications of the multipupil system and whose pupil function is the product of the complex pupil functions associated with each of the multipupils. The physical interpretation of the composite pupil function as a product is that the optical paths through corresponding areas of the multipupils are additive, while the corresponding amplitude transmissions are multiplied. The method of proof serves to extend the theory of phase microscopy to multipupil systems. A.

535.822 3726

An achromatic ultraviolet microscope objective. FOSTER, L. V., AND THIEL, E. M. *J. Opt. Soc. Amer.*, **38**, 689–92 (*Aug.*, 1948).—Microscopes have been used with monochromatic illumination because achromatism in the ultraviolet has not been common. A few different objectives achromatized for a band width of about 100 Å in the region 2 700 Å were made. These make use of fused quartz and fluorite. They can be used in other regions of the u.v. spectrum, but require readjustment of focus. A.

535.822–31 3727

Ultraviolet phase microscopy. BENNETT, A. H., WOERNLEY, D. L., AND KAVANAGH, A. J. Letter in *J. Opt. Soc. Amer.*, **38**, 739–40 (*Aug.*, 1948).—An experimental microscope using a 16-mm reflecting objective and fused quartz optical parts is briefly described and two sample photographs comparing the appearance of an object in visible and u.v. light are shown.

535.88 : 535.24 = 4 3728

Blondel's theory for calculating the illumination from a projector. DUNOYER, L. *C.R. Acad. Sci., Paris*, **226**, 1129–31 (*April* 5, 1948) *In French.*—Blondel and Lavanchy showed that at infinity the flashed area of a projector always lay at its centre no matter how far the point of observation lay off the axis. The author shows that, for a point at any finite distance, the flashed area lies off the centre, in the meridian of the point of observation, but that it approaches the centre rapidly as the ratio of l, the distance of the point of observation, to f, the focal length of the projector, increases. J. W. T. W.

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536.2.01 : 539.11 = 4 3729

The continuum theory and molecular theory of thermokinetic phenomena. VERNOTTE, P. *C.R. Acad. Sci., Paris*, **227**, 43–4 (*July* 5, 1948) *In French.*—In the problem of variable heat flow in a solid, treating the solid as a continuum, in spite of the obvious difficulties it introduces, is shown to lead to no real contradiction with experiment. S. W.

536.2.01 : 539.11 = 4 3730

An application of the molecular mechanism to an approximate theory of thermokinetic phenomena. VERNOTTE, P. *C.R. Acad. Sci., Paris*, **227**, 114–16 (*July* 12, 1948) *In French.*—A continuation of the preceding paper. It is pointed out that the essential characteristic of the molecular mechanism is that as the heat progresses equilibrium is not instantaneously attained. To introduce this into the continuous theory, D, the thermal diffusivity, is considered to be a function of time, t, equal to $D_0 t/\tau$ for small values of t, where D_0 is the full value of D attained after a time τ. A finite value for the initial heat flux is then obtained, but an immediate effect is still produced at every point of a conductor for a sudden change of temperature at one end. This physically impossible effect must be a consequence of the physical impracticability of establishing a sudden change of temperature, since the heat equation with D as a function of t is physically correct. S. W.

536.212.2 : 538.669 : 537.32 = 3 *see Abstr.* 3772

536.22 : 534.22 : 536.48 *see Abstr.* 3744

536.22 : 536.48 *see Abstr.* 3746

536.24 3731

Heat transfer with surface boiling. KNOWLES, J. W. *Nat. Res. Coun. Can., Publ.* (*No.* 1592) 22 *pp.* (*July* 15, 1948).—The effect of surface boiling on the heat transfer to flowing water was investigated. The temperature of the cooling water was below the boiling point and surface temperatures went to about 100°C above the boiling point. Water velocities ranged up to 10 ft/sec and heat fluxes up to 750 W/cm². Non-dimensional heat transfer constants about four times larger than for forced convection were obtained. The limitations of stability were studied extensively. Heat transfer correlation formulae were derived for two ranges of Reynolds numbers and two ranges of length/diameter ratios. They contain heat flux and heated length terms in addition to the usual variables of heat transfer. Some experiments on pressure drop are also included although they are difficult to interpret. A.

536.24.02 : 517.947.43 : 517.948.3 = 82 3732

The linear problem of Stefan. DATSEV, A. B. *C.R. Acad. Sci. URSS*, **58** (*No.* 4) 563–6 (1947) *In Russian.*—After an exposition of the problem [cf. Abstr. 3733 (1948)] and quoting Brillouin's [*Ann. de l'Inst. Poincaré*, **1** (1931)] unsuccessful attempt at a solution and Rubinstein's solution (l.c.) of a special case, the author expresses his opinion that this solution could not solve the problem of 2 media (phases) extending into the infinite. He then proceeds to solve the stated problem by a method totally different from Rubinstein's. The artifice used consists in considering at first a finite interval of time during which the movement of the boundary follows a prescribed, stepped curve, i.e. changes discontinuously. The solution is then given in the form of an improper integral, or functional equation, the Green function (or nucleus) of which has the form of the Laplace solution of the conduction equation. This auxiliary problem is then completely solved in Laplace's way, by the Gaussian error integral, as it would be called nowadays. As would be expected, the infinite problem is thus reduced to a variational problem based on the solution of the "artificial" problem, and must succeed. However, the final solution of the concrete problem has to rely on successive approximations.

536.24.02 : 517.947.43 : 517.948.32 = 82 3733

Determination of the position of the phase-separating boundary in the one-dimensional Stefan problem. RUBINSTEIN, L. I. *C.R. Acad. Sci. URSS*, **58** (*No.* 2) 217–20 (1947) *In Russian.*—Stefan's problem is that of heat

conduction without convection in a solid–liquid system, accompanied by the release of the latent heat of the phase transition. The temperatures u_1 and u_2 of the solid and liquid phase, respectively, have to satisfy the simple equation of heat conduction in x, t, with obvious initial and boundary conditions, apart from the fact that $x = y(t)$, is an unknown function of time, t, subject to $dy/dt = k_1\partial/\partial x u_1(x,t)|_{x=y(t)-0} - k_2\partial/\partial x u_2(x,t)|_{x=y(t)+0}$ In an earlier paper the author had given the existence and uniqueness theorems of the solution for $y(\theta) \neq 0$, $y(0) \neq 1$ by means of a system of integral equations for the temperature gradients of the two phases [*Bull. Acad. Sci. USSR, Geophys. and Geogr. Ser. No.* 1 (1947)]. However, the system, consisting of Fredholm equations for x, and Volterra type eqs. for t, did not admit of solutions failing a definition of $\partial u_i/\partial x$ in the phase domains. In the present paper the attempt is renewed by constructing the appropriate Green functions of the first and second boundary problem, and using the properties of the thermal potential of the double layer, allowing Stefan's condition to be expressed in integral form. This turns out to be the formal solution of the system of integral equations. The actual solution of the system is then provided by successive approximations, those of zero order based on arbitrary functions subject to appropriate conditions. The uniform convergence of these functions is proved and this confers the same character on the subsequent approximations. The uniqueness theorem of the solutions is then given.

536.244 3734

Mass and heat transfer in tube banks. WINDING, C. C., AND CHENEY, A. J., JR. *Industr. Engng Chem.*, **40**, 1087–93 (*June*, 1948).—A new experimental technique has been developed to obtain heat transfer coefficients in tube banks. Naphthalene tubes are cast in any desired shape and then inserted into various positions in a dummy tube bank. Mass transfer coefficients are obtained from the loss in weight and change in dimensions. Heat transfer coefficients are calculated by analogy for the transfer of heat and mass. Results obtained by this method are compared with available data for both single tubes and banks, and results appear to be well within the limits of accuracy. Some new information is presented for single streamline tubes and flat plates and for staggered round and streamline tube banks. A.

536.33 = 4 3735

The emissivity of cavities of simple geometric shapes. MICHAUD, M. *C.R. Acad. Sci., Paris*, **226**, 999–1000 (*March* 22, 1948) *In French.*—The values of the emissivity, ε_0, of a cavity of spherical, cylindrical or conical shape, for various values of L/R, where L is the depth and R the radius of the opening of the cavity, are calculated from the classical formula and tabulated. The emissivity of the material was taken as 0·5. The curve of $\varepsilon_0 = f(L/R)$ has a point of inflexion. The formula has been verified experimentally for a cavity consisting of a hollow cylinder of unpolished brass with a movable piston. Both were heated by a steady flow of water at 337°K. The results are shown graphically. S. W.

536.413 : 537.312.6 : 539.215 = 4 3736

On variations in the expansion and electric conductivity observed in titanium sesquioxide near 200°C. FOËX, M., AND LORIERS, J. *C.R. Acad. Sci., Paris*, **226**, 901–3 (*March* 15, 1948) *In French.*—Test bars of Ti_2O_3 made by compressing the powder and baking in vacuo showed a length contraction $\simeq 0{\cdot}5\%$ near 200°C and also a sudden increase in the electrical conductivity at the same temperature. It has been previously shown by Foëx that similar changes occur in V_2O_3 near 300°C. T. S. E. T.

536.422.15 : 537.226.8 : 621.315.616 : 533.5 *see Abstr.* 3650

536.423 : 532.525 *see Abstr.* 3631

536.423.15 : 532.694 = 3 *see Abstr.* 3637

536.423.15.08 3737

The absorption of organic vapours by thin films of polystyrene. BAUGHAN, E. C. *Trans. Faraday Soc.*, **44**, 495–506 (*July*, 1948).—Measurements were made of the vapour-pressure equilibrium. The technique consisted of weighing thin films of the polymer at measured vapour pressures of the low molecular component. Results are confined to free-energy data at 20°C, but cover several vapours ranging from those of liquids (benzene, toluene, *m*-xylene, CCl_4, butyl acetate, dioxane, diethylketone) in which polystyrene dissolves, to those of liquids (cyclohexane, propyl ether, nitromethane) in which it will only swell. The results are discussed in the light of recent theories. A.

536.45 = 4 3738

Transformations of cerium at high temperatures. LORIERS, J. *C.R. Acad. Sci., Paris*, **226**, 1018–19 (*March* 22, 1948) *In French.*—Samples of Ce of different origin and containing only small amounts of impurities have been studied by differential thermal analysis from 20° to 815°. Three discontinuities are revealed in the heating curve and are reproduced, with a slight drag to lower temperatures, in the cooling curve. Two, at ~ 710° and ~ 740°, show no marked change with composition and are most probably transition temperatures of Ce. The third is extremely sensitive to the amount of Fe in the sample, changing from ~ 640° when 0·0005% Fe is present to ~ 360° when the sample contains 1% Fe. W. R. A.

536.45 : 537.54 *see Abstr.* 3794

536.46 3739

The determination of flame speeds in gaseous mixtures. SHERRATT, S., AND LINNETT, J. W. *Trans. Faraday Soc.*, **44**, 596–608 (*Aug.*, 1948).—Shadow and direct photographs of the flame cones on a cylindrical burner burning a coal gas/air mixture were taken. A new procedure for using the cones on the shadow photographs to determine burning velocities is described. Conclusions regarding the form of the flame region are made. The effect of temperature on the burning velocity of a coal gas/air mixture was measured and the results are considered in the light of a formula for calculating burning velocity in terms of other properties of the combustible mixture. A.

536.46 : 535.338.1–15 *see Abstr.* 3681

536.46 : 538.569.2 : 537.58 *see Abstr.* 3807

536.462.08 : 536.521 = 4 3740

Measurement of the combustion temperatures of match pastes. ARDITTI, R., GAUDRY, H., AND LAURE, Y. *C.R. Acad. Sci., Paris*, **226**, 1179–80 (*April* 12, 1948) *In French.*—Using Kurlbaum's method, but with the pyrometer replaced by a barrier-layer cell with red filter and connected to a Moll galvanometer of high sensitivity, the combustion temperatures of different types of match pastes have been found to be constant for a given batch, and to lie between 1 350 and 1 390°C. The influence of the composition of the paste on the combustion temperature has also been examined. S. W.

536.468 : 537.521.7 3741

Ignition of explosive gas mixtures by electric sparks. Minimum ignition energies. VIALLARD, R. Letter in *J. Chem. Phys.*, **16**, 555 (*May*, 1948).—Recent conclusions of Lewis, von Elbe *et al.* [Abstr. 602, 603 (1948)], that certain minimum spark energies are

necessary for spark ignition of gases, are contrary to previous results of the author [*J. de chim. phys.*, **40**, 101 (1943)], which showed that, while minimum energies exist for given gas mixtures, they are not absolute values, but depend on spark voltage and gap geometry. No theory of these results is proposed, but they are shown to be consistent with recent results of Lewis and von Elbe when certain assumptions are made involving an ionization or electron-collision mechanism for ignition. F. LL. J.

536.48 3742

A possible explanation for the anomalous mechanocaloric heat effects in the supercritical flow of He II through slits. MEYER, L., AND BAND, W. *Physica, 's Grav.*, **14**, 63–4 (*April*, 1948) *In English.*

536.48 : 532.7 : 534.2 3743

The theory of the propagation of second sound in helium II. DINGLE, R. B. *Proc. Phys. Soc., Lond.*, **61**, 9–21 (*July*, 1948).—The conduction of heat is discussed and the velocity of sound, the attenuation and the reflection coefficients under various conditions are obtained. The shape of the velocity-temperature curve is discussed on the basis of Landau's theory [Abstr. 2532 (1942), 2176 (1945), 2052 (1947)] and Tisza's theory is criticized [Abstr. 252 (1948)]. A.

536.48 : 534.22 : 536.22 3744

The influence of relaxation on the two velocity field model of helium II. BAND, W., AND MEYER, L. *Phys. Rev.*, **74**, 386–94 (*Aug.* 15, 1948).—For previous work see Abstr. 1230 (1948). For a complete discussion of the unrelaxed, the fully relaxed, and the transition region, at least one more independent variable other than the two which specify the thermodynamic state of a system of one component in internal equilibrium is needed. In a Taylor expansion of the energy as a function of such a set of three variables the coefficients at partial or zero relaxation will differ from the ordinary values calculated from equilibrium thermodynamics. The wave equations ordinarily deduced are therefore modified. Expressions are obtained for the velocities of propagation of both sounds at infinite frequency (zero relaxation) and at zero frequency (full relaxation). At zero frequency, second sound reduces to thermal diffusion. Normal sound undergoes a sharp Einstein dispersion-and-attenuation at the lambda temperature where the relaxation time passes abruptly through the critical value for all generally used frequencies. The theory is used to compute x, the fraction of normal particles, from thermodynamic data and second sound velocity. The energy per normal particle is obtained as a function of temperature from x and the thermodynamic data on total heat content. A.

536.48 : 534.222 3745

Propagation of pulses of second sound in liquid He II. OSBORNE, D. V. Letter in *Nature, Lond.*, **162**, 213–14 (*Aug.* 7, 1948).—The velocity u_2 and amplitude T of temperature pulses of 0·1 to 1 msec duration travelling through He II were measured between 1·1° and 2·16°K using radar techniques. u_2 agrees well with the values of the second sound velocity obtained by earlier workers. The theoretically derived relation between T, the power flow per unit area W, and the specific heat per unit volume ρ_c: $T/W = 1/(\rho_c u_2)$ was confirmed within the experimental error. The method will be useful for the measurement of u_2 and ρ_c at temperatures below 1°K. H. L.

536.48 : 535.37 : 77.535 = 4 *see Abstr.* 4084

536.48 : 536.22 3746

Relaxation theory of thermal conduction in helium II. MEYER, L., AND BAND, W. *Phys. Rev.*, **74**, 394–6 (*Aug.* 15, 1948).—The equation for thermal diffusion derived previously [Abstr. 3744 (1948)] agrees with the relaxation equation for second sound, if the second sound velocity is corrected to zero frequency. The relaxation time τ is calculated to a higher accuracy. The peculiar property of the heat current in being proportional to the cube root of the temperature gradient can be reduced to the relation, $u_s^2\tau_s = J$, where u_s is the velocity of the superfluid balancing the mass flow of normal particles transporting the energy. τ_s is a relaxation time derived from τ, the relaxation time responsible for the damping of second sound, by the conditions for frequency balance. J appears to be a simple function of temperature only, approaching $h/m\pi$ at temperatures below 1°K. The equations lead to a qualitative understanding of the reduction of thermal conductivity by mass flow found by Kapitza. A.

536.48 : 536.63 3747

The atomic heats of palladium, sodium and mercury at low temperatures. PICKARD, G. L., AND SIMON, F. E. *Proc. Phys. Soc., Lond.*, **61**, 1–9 (*July*, 1948).—The specific heats of Pd and Na were measured between He and H temperatures, the specific heats of Hg between He and liquid air temperatures. Pd shows a very high electronic term of the specific heat. Na exhibits anomalous behaviour in various respects. In the case of Hg a search was made for a transition at low temperatures predicted by Bridgman, but no indication was found. The thermodynamic functions of the 3 metals between abs. zero and room temperature are given in tables. A.

536.483 : 621.56 = 3 3748

Theoretical contribution to the work of R. Hilsch on the "vortex tube." BURKHARDT, G. *Z. Naturforsch.*, **3a**, 46–51 (*Jan.*, 1948) *In German.*—It is shown that the phenomena occurring in the vortex tube of R. Hilsch [Abstr. 1512 (1947)] may, with suitable simplifications, be calculated in a satisfactory manner. This is made possible by the introduction of a separation factor which is used to describe the separation of the gases during the course of the expansion. Its magnitude and variation with the experimental conditions are evaluated by means of a plausible approximation. In this manner the temperature change of the emerging gases, the cooling or heating produced and the useful effect are calculated and the influence of different construction data on these is discussed. F. E. H.

536.521 : 536.462.08 = 4 *see Abstr.* 3740

536.531 : 621.317.733 : 621.317.39 3749

Resistance-thermometer bridge. STACK, S. S. *Gen. Elect. Rev.*, **51**, 17–21 (*July*, 1948).—[Abstr. 3023 B (1948)].

536.581.1 3750

A high temperature control circuit. LUTZ, B. C., AND WOOD, J. H. *Canad. J. Res. A*, **26**, 145–8 (*May*, 1948).—An electronic circuit useful in the control of electric air-bath furnaces having a long time lag is described. The control is accomplished by means of a relay that shunts a portion of the resistance in series with the furnace winding. The thermometric device is a thermocouple connected in series with a mirror-type galvanometer and a variable voltage supplied by a potentiometer. The setting of the potentiometer selects the temperature at which the device will control. A light beam falling on the mirror is reflected to one of two photocells. One photocell closes the shunt by means of the described circuit and increases the current in the furnace. This condition is maintained until the beam moves across the second

photocell, when the shunt is again opened. The device will control temperatures over 1 000°C within a precision of ± 2°C over any desired length of time. A.

536.63 : 536.48 *see Abstr.* 3747

536.666 : 541.115 : 539.133 *see Abstr.* 3854–6

THERMODYNAMICS 536.7/.8

536.7 : 571.124 = 4 3751

On the thermomechanics of open systems. VERSCHAFFELT, J. E. *Bull. Acad. R. Belge Cl. Sci.* (*Sér.* 5) **34** (*No.* 1) 17–38 (1948) *In French.*—Following R. Defay, thermodynamic systems are termed open if they are able to interchange matter, and not only energy, with their surroundings. The object of the present paper is to examine how the two fundamental laws of thermodynamics have to be modified in order to be applied to a system consisting of several phases, the mass and the state of which vary by exchange of matter with the environment. F. E. H.

536.71 3752

An approximate equation of state. RODRIGUEZ, A. E. Letter in *Nature, Lond.*, **162**, 304 (*Aug.* 21, 1948).—Born and Green [Abstr. 1148 (1947)] derived a new equation of state for both liquid and gas phases. The theory showed that the difference between the liquid and the gas corresponded to the existence or non-existence of real roots of a certain transcendental equation. In the original form, this was an integral equation, but it has now been reduced to an algebraic form, so that the definition of the complex roots is unambiguous. Some numerical results (with diagrams of two isotherms at 130° and 150°K) for A are now reported. The theory of condensation developed by Mayer [Abstr. 979 (1938)] and others is confirmed to the extent that a divergence of the cluster series is found, but the new data differ from Mayer in that the point of divergence is at the minimum of the curve which separates the metastable states of the liquid and gas. H. H. HO.

536.71 : 530.145 *see Abstr.* 3598

536.71 : 533.21 = 4 *see Abstr.* 3647

536.712 : 541.183 *see Abstr.* 4005

536.75 : 539.132 *see Abstr.* 3852

536.75 : 539.32 *see Abstr.* 3968–70

ELECTRICITY 537

537.12 : 530.145.6 : 548.0 = 82 *see Abstr.* 4015

537.12 : 539.166.835 *see Abstr.* 3909–10

537.122 : 530.14 *see Abstr.* 3594

537.122 : 537.591.1 *see Abstr.* 3816

537.122 : 539.152 *see Abstr.* 3860

537.122 : 539.152.1 *see Abstr.* 3864

537.13 : 539.164 : 771.535 = 3 *see Abstr.* 4085

537.132 : 537.533.74 = 4 *see Abstr.* 3791

537.133 : 539.185 : 530.145 *see Abstr.* 3599

537.133 : 539.185 : 530.145 = 4 *see Abstr.* 3602

537.165.08 3753

Beta-ray spectrometer magnetic shielding. ALBURGER, D. E. Note in *Rev. Sci. Instrum.*, **19**, 474–5 (*July*, 1948).

537.226 : 538.569.3 = 82 3754

Dispersion and absorption of short waves in glycerine. KOSLOBAEV, J. P. *J. Exp. Theor. Phys.*, **18**, 548–51 (*June*, 1948) *In Russian.*—Dielectric constants and absorption coefficients are given, and the molecular polarizations of the glycerine for wavelengths from 100 to 350 cm are determined. The results are compared with those due to other workers, and with Debye's dipole theory. A.

537.226.1 = 4 3755

Static dielectric constant of polyvinyl chloride. CHARBONNIÈRE, R. *C.R. Acad. Sci., Paris*, **226**, 909–10 (*March* 15, 1948) *In French.*—The static dielectric constant of polyvinyl chloride (molecular weight 50 000), determined by measurements using d.c., was found to be 3·2 at 20°C. It was practically constant up to 65°C and then increased sharply. E. R.

537.226.2 : 538.569.3 : 541.135 3756

Absorption of u.h.f. waves in salt solutions. CHATTERJEE, S. K., AND SREEKANTAN, B. V. *Indian J. Phys.*, **22**, 229–42 (*May*, 1948).—The absorptions of waves (300–500 Mc/s) in aqueous solutions of NaCl of different concentrations were measured by an optical method. Attenuation coefficients and absorption indices were calculated for different frequencies. Values of reflection coefficients at different frequencies were also calculated. Values of ionic relaxation times, obtained experimentally for different concentrations of the solution, were compared with the values calculated from the Debye–Falkenhagen theory. Values of permittivity and loss tangent, as deduced from experimental results, were also compared with those calculated theoretically. The dipole conductivity and molar conductivity were calculated from experimental results and their variation with frequency studied. It was found that the position of maximum absorption shifts towards higher concentration for higher frequencies. The product of wavelength corresponding to maximum absorption and the normality of the solution expressed in g-equiv./l was found to be constant (16·64). A.

537.226.2 : 621.315.61.029.5 3757

Dielectric properties of some solid insulating materials at 750 Mc/s. CHATTERJEE, S. K. *Indian J. Phys.*, **22**, 157–66 (*April*, 1948).—Dielectric constants and power factors of materials like mica, mycalex, plexi-glass, etc., were measured at 750 Mc/s. A resonant line oscillator, having tuned concentric lines in the filament circuit, was constructed for the purpose. The detector, which is also of the resonant line type, was constructed for voltage measurement. Loss factors and power dissipated in watts in the materials were calculated from observed results. A.

537.226.2 : 621.315.61.029.5 3758

Dielectric constants of some solid insulating materials at ultra short waves. CHATTERJEE, S. K., AND RAJESWARI. *Indian J. Phys.*, **22**, 180–8 (*April*, 1948).—The constants of materials in the form of thin slabs were measured by the Lecher wire method over a wavelength range of 140 cm to 57·7 cm; they vary with the wavelength. In the case of solid paraffin, the constants increase with decreasing wavelength, but in other cases the constants decrease. A.

537.226.2 : 621.317.37 3759

A method for measuring the complex dielectric constant of gases at microwave frequencies by using a resonant cavity. JEN, C. K. *J. Appl. Phys.*, **19**, 649–53 (*July*, 1948).—A sensitive method was developed for measurement at 3 cm wavelengths. The gas is contained in a resonant cavity which is a part of the microwave circuit. With the introduction of the gas, the real part of the permittivity changes the resonant frequency of the cavity, while the imaginary part changes the amplitude and breadth of the cavity response curve. By a rapid variation of the frequency across the cavity resonance, the real and imaginary parts can be conveniently and

accurately determined from measurements on an oscilloscope. Tests on such a system have been performed with satisfactory results. Sample data are presented for CH_3Cl and ND_3. The method can be used for the measurement of the resonant dispersion and absorption of microwaves by gas molecules; also for the measurement of loaded and unloaded Q-values of a cavity. A.

537.226.2.08 = 4 3760

Measurements of the dielectric constants of electrolytic solutions. DARMOIS, E. *C.R. Acad. Sci., Paris*, **226**, 1192–4 (*April* 12, 1948) *In French.*—Such measurements have been made from 1891 onwards, at first by damped and then by means of sustained oscillations. Experimental details are included and discussed with modifications for extreme dilution, while comparisons are made with the comprehensive data of Lattey and Davies [Abstr. 2526 (1932)]. H. H. HO.

537.226.3 : 621.3.017.143 = 4 3761

Dielectric losses. GRANIER, J. *C.R. Acad. Sci., Paris*, **226**, 1354–6 (*April* 26, 1948) *In French.*—The simple Debye expression $\varepsilon'' = Ax/(1 + x^2)$ or $1/\varepsilon'' = B(x + 1/x)$, where ε'' = loss factor and $x = \omega\tau$, τ = dipole relaxation time and ω = angular frequency, does not hold for many insulating materials. It is suggested that the relation $1/\varepsilon'' = B(x^n + 1/x^n)$, where $0 < n < 1$, represents the dielectric behaviour more accurately, and values of ε'' calculated by this means agree well with the measured values for glycerine and phenolic resin. In cases where τ is large and ε'' appears to reach its max. at v.l.f., the relation simplifies to $1/\varepsilon'' = C\omega^n$. E. R.

537.226.33 3762

Voltage effects in titanate polycrystals. PARTINGTON, J. R., PLANER, G. V., AND BOSWELL, I. I. Letter in *Nature, Lond.*, **162**, 151–2 (*July* 24, 1948).—See Abstr. 965 (1948). Changes of permittivity were measured immediately following the application of a d.c. field of 3 300 V/cm. The eventual fall to a lower value is preceded by, above the Curie point, an initial rise, and below the Curie point, an initial partial fall. It is suggested that, on the application of the field, oriented regions grow at the expense of others, and the resulting anisotropic stresses lower the Curie point in some of the crystallites.

537.226.8 : 621.315.616 : 536.422.15 : 533.5 *see Abstr.* 3650

537.228.1 : 548.0 3763

Compressional piezoelectric coefficients of monoclinic crystals. JAFFE, H. Letter in *Phys. Rev.*, **73**, 1467 (*June* 15, 1948).—Direct measurements of the piezoelectric coefficients of K tartrate hemihydrate (DKT) and ethylene diamine tartrate (EDT) are quoted to show that the observed effects are much smaller than would be expected from the values given by Mason [Abstr. 1036 (1947), 177 B (1948)]. H. J. H. S.

537.228.2 3764

Piezoelectric or electrostrictive effect in barium titanate ceramics. MASON, W. P. Letter in *Phys. Rev.*, **73**, 1398–9 (*June* 1, 1948).—The nomenclature of Matthias and Von Hippel [Abstr. 1545 (1948)] is criticized, and experimental evidence is quoted to show that the effects observed with $BaTiO_3$ are electrostrictive rather than "quadratic" piezoelectric effects. H. J. H. S.

ELECTRIC CURRENTS 537.3

537.3.08 : 541.135.2 3765

A new and easily constructed precision coulometer. ABERS, E. L., AND NEWTON, R. F. *J. Phys. Coll. Chem.*, **52**, 955–8 (*June*, 1948).—A new type of Hg coulometer has been developed having an accuracy of better than 0·03%. Liquid Hg is used for both anode and cathode (electrical contact being made with Ni electrodes). The electrolyte is a solution of HgI_2 in excess KI. This coulometer is very easy to construct and all the materials are readily obtainable. The max. current measured was 3·4 A (current density 0·75 A/cm²). Below a current density of 0·024 A/cm² the accuracy fell off, but was better than 0·1%. A.

537.311 : 539.32 *see Abstr.* 3971

537.311.33 : 538.632 = 3 *see Abstr.* 3843

537.311.33 : 541.183.2 *see Abstr.* 4007

537.311.33 : 621.314.634 = 3 3766

Simplified and extended theory of boundary layer rectifiers. SCHOTTKY, W. *Z. Phys.*, **118** (*Nos* 9–10) 539–92 (1942) *In German.*—An approx. 10^{-5} cm thick boundary layer with completely ionized electron-emitting centres is postulated, and enables a much simplified theory of a.c. and d.c. rectifier characteristics to be given; calculated and experimental characteristics of Bi/Se and Mg/Se rectifiers agree well at higher temperatures, but deviate considerably at low temps. Possible reasons for this anomaly are discussed. Good rectifier combinations should have low emitting-centre density coupled with fairly high conductance of the respective semi-conductor. Measurements on Cu_2O rectifiers agree with the theory; and their emitting-centre distribution near the effective electrode is determined by capacity measurements. V. W. R.

537.311.35 : 539.16.08 3767

Conductivity pulses in liquid argon. DAVIDSON, N., AND LARSH, A. E., JR. Letter in *Phys. Rev.*, **74**, 220 (*July* 15, 1948).—Two Pt electrodes, 5 mm diameter, 1 mm apart, were immersed in liquid A. Conductivity pulses were observed due to Po α-particles from a source condensed on the negative electrode, when fields of 1 000–10 000 V/cm were applied. The pulse size increased for fields up to 5 000 V/cm, but not above. No pulses were observed with liquid N or *n*-heptane at room temperatures. The absence of an accumulation of space charge is claimed as an advantage of the liquid counter over the crystal counter. R. W. P.

537.311.62 3768

Measurements of radio frequency resistance of a piece of columbium nitride through the transition. LEBACQZ, J. V. *Phys. Rev.*, **73**, 1476 (*June* 15, 1948).—No difference was found between the r.f. resistance up to 1 Mc/s and the d.c. resistance through most of the transition to superconductivity. This was to be expected in view of the high specific resistance and consequent absence of skin effect. D. S.

537.312.5 3769

The photo-voltaic effect. LEHOVEC, K. *Phys. Rev.*, **74**, 463–71 (*Aug.* 15, 1948).—The Schottky–Mott theory of the barrier layer rectification is extended with respect to the action of light absorbed in the barrier layer. The essential physical assumptions used are: (1) The barrier is a boundary layer of a semiconductor with a reduced density of mobile charges; (2) both positive and negative mobile charges are released by light; (3) the recombination within the barrier layer is negligible; and (4) the electrons and "holes" have the same properties whether released by light or by thermal agitation. An equation of state connecting photo-voltage, photo-current, light intensity, wavelength, external resistance, etc., is derived. A.

537.312.5 : 535.215.2/.5 : 537.583 = 3 *see Abstr.* 3809

537.312.5 : 548.0 : 535.37 = 3 *see Abstr.* 3703

537.312.6 : 539.215 : 536.413 = 4 *see Abstr.* 3736

537.312.62 = 3 3770

An extension of the theory of superconductivity. V. LAUE, M. *Naturwiss.*, **34** (*No.* 6) 186 (1947) *In German.*—For the application of the Londons' theory of superconductivity [Abstr. 1797 (1935)] to non-cubic crystals the scalar λ is replaced by a symmetrical tensor so that the vector (λJ) has the components $(\lambda J)_i = \Sigma\lambda_{ik}J_k$. Most of the general features of the theory (persistent currents, Meissner effect, thermodynamics of phase transition into the normal state) remain practically the same, with the only difference that the exponential decay of the magnetic field and the current density is given by *two* exponential functions depending on the crystallographic position of the boundary. A new feature, however, is the fact that the stress tensor is no longer symmetrical inside the superconductor. This causes an angular momentum per unit volume $J\times(\lambda J)$ to be exerted upon the superconducting electrons. H. L.

537.312.62 = 3 3771

On the theory of superconductivity. II. Calculation of the transition temperature. KOPPE, H. *Z. Naturforsch*, **3a**, 1–5 (*Jan.*, 1948) *In German.*—By considering the exchange energy between electrons of equal spin it is possible to evaluate a numerical factor which has been left open so far in Heisenberg's theory of superconductivity [Abstr. 3203 (1947)]. This makes it possible to determine the transition temperature as a function of the atomic volume and the number of valency electrons. The author points out that his formula has the character of approximation based on the free electron model. Although fairly good agreement with experiment is found for some superconductors the theoretical formula would give a high transition temperature for the alkali metals, for which superconductivity has actually not been observed. H. L.

537.32 : 538.669 : 536.212.2 = 3 3772

The relation between the isothermal and adiabatic Ettinghausen–Nernst coefficient. KOHLER, M. *Z. Phys.*, **118** (*Nos* 5–6) 312–16 (1941) *In German.*—When heat flows through a transversely magnetized metal plate, a transverse electric p.d. is set up corresponding to the Ettinghausen–Nernst effect. N. H. Frank [Abstr. 231 (1931)] deduced that the adiabatic Ettinghausen–Nernst constant = 2 × isothermal constant, which is not in accord with experimental evidence. The author, by considering the thermoelectric field strength at the connecting wires in the adiabatic cases, finds the adiabatic constant = isothermal const., provided the plate and connecting wires are of similar material and the thermal forces between magnetized and non-magnetized metal are small. V. W. R.

537.322 3773

Measurements of Thomson coefficients for metals at high temperatures and of Peltier coefficients for solid-liquid interfaces of metals. LANDER, J. J. *Phys. Rev.*, **74,** 479–88 (*Aug.* 15, 1948).—The relevant apparatus is described. In the range from 400°C to the melting point the approximation $\sigma = \beta T$ is adequate for Pt, Pd, Cu and Ag, but not for Au, Mo and W. Experimental results for the Peltier coefficients for solid-liquid interfaces of Au, Ag and Cu are also reported. An experimental sensitivity of 0·1 mV revealed no effect in Au and Ag, but +10·2 mV was obtained for Cu. A.

537.323 : 669.018 = 4 3774

The variation of the thermoelectric power of metals with dissolved elements. CRUSSARD, C., AND AUBERTIN, F. *C.R. Acad. Sci., Paris*, **226,** 1003–5 (*March* 22, 1948) *In French.*—The thermoelectric power at 20°C of several Al alloys, formed by the addition of a known quantity of either Sn, Si, Ti, Cr, Mn, Fe, Ni, Cu or Mg to 99·995% Al, relative to Al, have been measured. The alloys were produced in two ways: by quenching from 600°C, and by slow cooling over a period of 48 hours. The power for the slowly cooled alloy is never > that for the quenched. The results, together with those to be found in the literature for other bases, confirm that, with a few exceptions, the dissolved element increases or decreases the thermoelectric power of the base according as the element is to the left or right of the base in the 8 column periodic table. S. W.

ELECTRIC DISCHARGES AND RADIATIONS 537.5

537.52 3775

Breakdown of a gas at microwave frequencies. HERLIN, M. A., AND BROWN, S. C. *Phys. Rev.*, **74,** 291–6 (*Aug.* 1, 1948).—The criterion for breakdown of a low pressure gas at microwave frequencies is that ionization by collision of electrons with neutral gas molecules replace loss by diffusion to the walls of the discharge tube. The condition is mathematically expressed as a simple boundary value problem. This breakdown principle is applied to converting microwave breakdown measurements into measurements of ionization rates as a function of the electric field strength, pressure and frequency. A new ionization coefficient is introduced appropriate to the high frequency discharge conditions, and its relation to the d.c. Townsend coefficient is explained. The energy transfer from the electric field to the electrons at a given E/p is shown to be most efficient when the pressure is high enough or the frequency low enough to result in many collisions of electrons with gas molecules per cycle. This maximum efficiency is equal to the d.c. energy transfer efficiency. When the pressure is lower or the frequency is higher, the electrons have an out-of-phase component of motion and do not receive energy so efficiently, resulting in lower ionization rates observed experimentally. A.

537.52 3776

The initiation of low pressure glow discharges. CRAGGS, J. D., AND MEEK, J. M. *Proc. Phys. Soc., Lond.*, **61,** 327–40 (*Oct.*, 1948).—Oscillographic studies of some transient low pressure gaseous discharges have been made, with particular attention to the intermittent discharges occurring before stable self-maintained glow discharges are established. The nature of these pre-glow discharges varies considerably with the nature of the gas, and attempts are made to interpret them in relation to Weissler's corona work. A.

537.521.7 : 536.468 *see Abstr.* 3741

537.523.4 3777

The threshold for spark development by streamer mechanism in uniform fields. LOEB, L. B. *Phys. Rev.*, **74,** 210–12 (*July* 15, 1948).—Outlines a method for the evaluation of sparking thresholds, using the author's criterion for streamer advance $Kf\epsilon^{\alpha\delta} = 1$ where α and δ have their usual significance and where K and f involve the formation of photo-ionizing radiations and their absorption. The new equation for sparking thresholds involves K and f and cannot easily be used, at present, for practical purposes. J. D. C.

537.523.4 3778

Development of spark discharge. SAXE, R. F., AND MEEK, J. M.; ALLIBONE, T. E. *Nature, Lond.*, **162,** 263–4 (*Aug.* 14, 1948).—Describes a new experimental technique

(electron multiplier tube, amplifier and oscillograph) for the investigation of the leader strokes preceding spark discharges. The speed of leader stroke propagation, and the variations in space and time of the light radiation are determined. J. D. C.

537.523.4 : 537.527.4 3779

Certain aspects of mechanism of spark discharge. LOEB, L. B. *Proc. Phys. Soc., Lond.*, **60**, 561–73 (*June*, 1948).—It is shown how sparks may occur for voltages $V < V_s$ (set by $\gamma e^{\alpha\delta} = 1$ in the usual notation) and may not occur for $V > V_s$. This leads to a definition of V_s given by $dP_s/dV = \text{max.}$ where P_s is the fraction of initiating electrons which produce sparking. Next, the relation between the Townsend and streamer mechanisms is discussed and the criterion for streamer advance, at the threshold of sparking, is put as $efe^{\alpha x} = 1$, where e is a probability factor and f relates the number of photons to the number of electrons produced in the avalanche tip. Finally, it is shown that Meek's equation $[V_s = f_1(p, \delta)]$ predicts certain deviations from Paschen's law which are experimentally observed. J. D. C.

537.523.5 : 621.385.82 : 537.542 *see Abstr.* 3799

537.525 : 538.56 = 3 3780

Theory of electron plasma oscillations. SEELIGER, R. *Z. Phys.*, **118** (*Nos* 9–10) 619–23 (1942) *In German.*—The Langmuir electron plasma oscillation equation is derived by (1) combining the equations of potential and motion with the equation of continuous electron flow, or (2) resolving the total current into a displacement and a convection component. The relations between these two points of view are discussed, and they are shown to be perfectly equivalent. V. W. R.

537.527.4 : 537.523.4 *see Abstr.* 3779

537.53 : 535.23 = 4 *see Abstr.* 3665

537.531 3781

Absorption of X-rays in air. DAY, F. H., AND TAYLOR, L. S. *J. Res. Nat. Bur. Stand., Wash.*, **40**, 393–9 (*May*, 1948).—The absorption in air of X-rays produced by voltages from 10 to 200 kV (constant potential) for various initial filtrations was studied. A free-air ionization chamber on tracks was used to obtain absorption data over a 150 cm distance. No appreciable change in quality of X-rays was observed in this distance because of the air absorption. The effective air absorption coefficients for heterogeneous X-rays of various qualities were determined. A.

537.531 = 4 3782

Influence of voltage on the $L\alpha$ satellites of gold. VALADARES, M., AND MENDÈS, F. *C.R. Acad. Sci., Paris*, **226**, 1185–7 (*April* 12, 1948) *In French.*—Experiments on the $L\alpha_1$ satellites of Au show that they cease to be produced when the exciting voltage falls below the L_I excitation potential, thus confirming the theory of Coster and Kronig [Abstr. 1693 (1935)]. W. E. D.

537.531 : 533.583 : 541.182.5 *see Abstr.* 4003

537.531 : 535.34 : 541.27 = 4 3783

Influence of the valency of rhenium on its X-ray absorption spectrum. MANESCU, I. *C.R. Acad. Sci., Paris*, **226**, 1010–12 (*March* 22, 1948) *In French.*—Certain differences are examined in the absorption spectrum of Re in the metallic and combined states (valency IV in $ReO_2 . 2H_2O$ and valency VII in $KReO_4$ anhydrous). The absorption frequency is found to increase from Re to Re^{IV} to Re^{VII}. The differences in the detailed structure of the spectra are correlated with the difference in the structure of the materials. W. E. D.

537.531 : 535.372 378

A Geiger counter spectrometer for X-ray fluorescence analysis. FRIEDMAN, H., AND BIRKS, L. S. *Rev. Sci. Instrum.*, **19**, 323–30 (*May*, 1948).—The instrument is capable of measuring the K series lines of the elements beginning at atomic number ~22, up to ~50. In the middle portion of this range, spectrochemical analyses can be performed rapidly with a sensitivity of 1 in 10 000. Although the intensities are considerably reduced, analyses may still be carried out, using the L series spectra of the elements above atomic number 55. A.

537.531 : 535.42 : 539.163.2 *see Abstr.* 3898

537.531 : 537.533 : 578.088 *see Abstr.* 4078–9

537.531 : 548.7 = 4 3785

The diffusion of X-rays through a partially ordered lattice. GUINIER, A., AND GRIFFOUL, R. *Acta Cryst.*, **1**, 188–93 (*Sept.*, 1948) *In French.*—The diffuse reflections were computed, for a special case, in terms of a single parameter, the degree of short-range order. In the case of a 3-dimensional lattice the results obtained are applicable only in particular cases; in general, the order cannot be defined by a single parameter, and it is necessary to specify the degree of both short- and long-range order. A.

537.531.74/.92 : 615.849 : 612.014.481.079 *see Abstr.* 4081

537.533 : 537.531 : 578.088 *see Abstr.* 4078–9

537.533 : 621.384.6 3786

Waves and electrons traveling together—a comparison between traveling wave tubes and linear accelerators. BRILLOUIN, L. *Phys. Rev.*, **74**, 90–2 (*July* 1, 1948).—[Abstr. 2778 B (1948)].

537.533.7 : 621.384.6 = 4 3787

Electron dynamics in a linear accelerator. MESSIAH, A. *C.R. Acad. Sci., Paris*, **226**, 1357–9 (*April* 26, 1948) *In French.*—[Abstr. 2779 B (1948)].

537.533.72 3788

Velocity and two-directional focusing of charged particles in crossed electric and magnetic fields. SVARTHOLM, N. Letter in *Phys. Rev.*, **74**, 108–9 (*July* 1, 1948).—If a magnetic field with strength decreasing with increasing radius as

$$H(r) = H_0[1 + \alpha_1(r - r_0)/r_0 + \alpha_2(r - r_0)^2/r_0^2 + \ldots]$$

is combined with a radial electric field

$$E(r) = E_0[1 + \beta_1(r - r_0)/r_0 + \beta_2(r - r_0)^2/r_0^{2\alpha} \ldots],$$

then radial and axial focusing occurs after angles

$$\phi_r = \pi/[1 + (\kappa - 1)(\kappa - 2) + \alpha_1\kappa + \beta_1(1 - \kappa)]^{\frac{1}{2}}$$

and $$\phi_z = \pi/[\kappa - 1 - \alpha_1\kappa - \beta_1(1 - \kappa)]^{\frac{1}{2}},$$

where $\kappa = er_0H_0/mv_0$. The importance of this result in several special cases is discussed. R. W. P.

537.533.72 : 539.165 3789

Optimum conditions for a beta-ray solenoid spectrometer. PERSICO, E. Letter in *Phys. Rev.*, **73**, 1475–6 (*June* 15, 1948).—For a point β-ray source and uniform magnetic field ring focus spectrometer, the best resolving power for a given luminosity is obtained with $\alpha = 42° 20'$, the baffle system admitting only those rays which leave the source at an angle $\alpha \pm \Delta\alpha$ to the field. The inverse resolving power is $\Delta p/p = 0{\cdot}032\, w^2$. [See also Abstr. 2135 (1948)]. The factors which limit the resolution for a source of finite diameter S are discussed. The optimum conditions are approximately $\alpha = 40° 25'$ and $S/D = 11{\cdot}4\,(\Delta\alpha)^2 = 0{\cdot}172\, w^2$, if $D = 2p/He$. The inverse resolution is $\Delta p/p = 0{\cdot}156\, w^2$, the radius of the ring focus is $0{\cdot}544\, D$ and the distance of its plane from the source is $1{\cdot}63\, D$. It is claimed that a spectrometer

so designed would have a luminosity more than 7 times > the Witcher spectrometer [Abstr. 2182 (1941)] for the same resolving power. R. W. P.

537.533.73 : 541.6 *see Abstr.* 4012

537.533.74 = 3 3790

Inelastic scattering and discrete velocity-loss of fast electrons. V. Borries, B., and Koppe, H. *Naturwiss.*, **34** (*No.* 6) 187 (1947) *In German.*—The results of a theory of energy losses for fast electrons colliding with ionic cores are given; it is assumed that the most probable energy loss corresponds to the ionization energy. Experimental support for the theory is presented, for scattering of 5·3 keV electrons on Al. A. P. F.

537.533.74 : 537.132 = 4 3791

On elastic collisions between positive and negative electrons. II. Ho, Z.-W. *C.R. Acad. Sci., Paris*, **226**, 1083–5 (*March* 31, 1948) *In French.*—Previous results [Abstr. 3161 (1946)] have been confirmed by photographs of 150 collisions of positrons from $^{18}_{9}F$ with electrons, making a total of 328 collisions in the two experiments. The frequency of an energy transfer > 50% is definitely larger than that given by theory, and that of an energy transfer < 50% is less. G. J. K.

537.533.8 = 82 3792

Bremsstrahlung of electron collisions. Lifshits, E. M. *J. Exp. Theor. Phys.*, **18**, 562–5 (*June*, 1948) *In Russian.*—The effective cross-section for bremsstrahlung in electron collisions is determined for the non-relativistic quantum case ($c \gg v \gg e^2/h$, where v = electron velocity). The spectral and angular distribution of the radiation is given. A.

537.534.74 : 539.174 *see Abstr.* 3942

537.54 3793

An improvement of α-particle counters. Guimarães, M. A., and Sampaio, P. A. Note in *Rev. Sci. Instrum.*, **19**, 475–6 (*July*, 1946).—See Abstr. 1942 (1945).

537.54 : 536.45 3794

Electrode vapour jets in arc and spark discharges. Finkelnburg, W. Letter in *Phys. Rev.*, **74**, 222–3 (*July* 15, 1948).—Attention is drawn to correlation between recent work of Haynes [Abstr. 2477 (1948)], in which high velocity vapour jets were shot from Hg electrodes by spark discharges, and previous work of Finkelnburg on the high current C arc. Comparison is made of the two sets of similar phenomena; the authors propose different jet mechanisms: Haynes gives an electric theory while Finkelnburg prefers a thermal theory. F. Ll. J.

537.542 3795

Self-quenching halogen-filled counters. Liebson, S. H., and Friedman, H. *Rev. Sci. Instrum.*, **19**, 303–6 (*May*, 1948).—Counters filled with small percentages of the halogens mixed with the inert gases produced self-quenching counters. The lifetimes of these counters in terms of total counts are apparently unlimited. Several mixtures exhibited thresholds below 250 V at total pressures ordinarily used in counters. Pulse size, efficiency and quenching characteristics are similar to those obtained with A–C_2H_5OH Geiger–Mueller counters filled with a 10% mixture to total pressures >10 cm Hg. The percentages of halogens required to make good counters were about the same as the optimum concentrations reported for quenching metastable states in the rare gases. A.

537.542 3796

The effect of the composition of the gas mixture in self-quenching Geiger–Müller tubes on their plateau characteristics. du Toit, S. J. Letter in *Phys. Rev.*, **73**, 1473–4 (*June* 15, 1948).—Experiments were made at 40°C with three counters, identical except with respect to wire diameters, to test theories of the vanishing of the plateau of a given tube with a sufficiently high pressure of the quenching gas. [See Weisz, Abstr. 728 (1943); Rochester and McCusker, Abstr. 805 (1946)]. The results suggest that the disappearance of the plateau when the filling is pure alcohol is due to the photon absorption becoming too high (Weisz), but that the addition of 0·5 cm of A changes the phenomenon in such a way that secondary emission from the cathode at the threshold voltage is now responsible for the plateau becoming zero (Rochester and McCusker). R. W. P.

537.542 3797

Dead-time reduction in self-quenching counters. Smith, P. B. *Rev. Sci. Instrum.*, **19**, 453–7 (*July*, 1948).—The various methods of dead-time reduction are investigated and discussed. The application of a large negative voltage pulse to the centre wire, just after the discharge starts, reduces the dead-time. This effect is due to a combination of stopping the propagation of the ion sheath, ion neutralization, and ion multiplication. In the most favourable case found, the dead-time of a Geiger tube having a normal dead-time of 160 μsec is reduced to 80 μsec by this means. Increasing the gain of the detecting circuit without a negative pulse does not reduce the dead-time more than a factor of 2, unless the counting rate is greatly increased so that all pulses are small. Operation with high gain just below the Geiger threshold shows efficiency of the order of 50% for β-particles, and no measurable dead-time. A.

537.542 3798

Discharge spread in Geiger counters with methane and methane/argon fillings. Balakrishnan, C., Craggs, J. D., and Jaffe, A. A. *Phys. Rev.*, **74**, 410–14 (*Aug.* 15, 1948).—Further measurements with a split-cathode Geiger counter are described. [See Abstr. 1546 (1947), 355 (1948)]. A.

537.542 : 537.523.5 : 621.385.82 3799

Construction and performance of a low voltage arc as a source of positive ions. Allison, S. K. *Rev. Sci. Instrum.*, **19**, 291–8 (*May*, 1948).—A low voltage arc of the "capillary" type which has given reliable performance since its installation in 1940 is described. The design stresses simplicity and reliability, but no special attempt is made to attain very low consumption of gas. Operating at an arc current of 0·75 A and consuming 25 cm^3 of deuterium at N.T.P. per hour, a total beam current of 1·1 mA is produced with a probe potential of 3 500 V. About 50 μA of deuterons, magnetically selected from this beam, can be focused on a target. A.

537.542 : 539.16.08 3800

The geometric efficiency of certain pulse ionization chamber configurations. Jackson, J. D. *Nat. Res. Coun. Can., Publ.* (*No.* 1664) 26 *pp.* (*Dec.* 1, 1947).—The geometric efficiency, defined as the ratio of the number of ionizing particles counted to the total number of ionizing particles occurring in the ionization chamber, is calculated as a function of the minimum detectable track length within the chamber. Formulae are given for parallel plate, spherical, and cylindrical types of geometry. Typical curves are shown for parallel plate and spherical ionization chambers, while the cylindrical geometry is illustrated by the consideration of an example from actual experiment. The procedure for reducing experimental data to geometrical data, or vice versa, for purposes of comparison is also outlined. The details of mathematical calculation are included. A.

537.542 : 539.16.08 3801

Multiple Geiger counters for the observation of particle tracks. CHAMBERS, W. H. *Rev. Sci. Instrum.*, **19**, 467–70 (*July*, 1948).—An array of 16 self-quenching Geiger counters is described, which employs a matrix of parallel, small diameter wires for electrodes. The gas atmosphere is common to all counters. The array and attendant recording circuit is used to observe the tracks of charged particles. A spurious count, caused by incomplete absorption of the photons by the polyatomic gas, occurs in a counter adjacent to the track for ~1·5% of the primary tracks. A.

537.542 : 539.16.08 *see Abstr.* 3880

537.542 : 539.165.08 3802

Beta-ray counters. KRISHNAN, R. S. *Curr. Sci.*, **17**, 37–43 (*Feb.*, 1948).—An elementary account of the construction and operation of thin-walled counters for β-ray studies, including some details of a demountable counter for the study of the absorption of very soft β-rays. R. W. P.

537.542 : 539.165.08 3803

An inside Geiger–Müller counter for soft beta-emitters. LABAW, L. W. *Rev. Sci. Instrum.*, **19**, 390–5 (*June*, 1948).—A practical inside Geiger–Müller counter for the detection of soft β-rays and α-particles is described in conjunction with a simplified method for the preparation of samples for assay. Direct determination of the specific activity of samples having different chemical composition can be made simply without an initial chemical extraction of the active element. A.

537.56/.58 = 82 3804

Fluctuations of ionization tracks. POMERANCHUK, T. *J. Exp. Theor. Phys.*, **18**, 759–66 (*Aug.*, 1948) *In Russian.*—The influence of multiple scattering on ionization tracks is investigated. Expressions are derived for the extension of the trajectories under repeated scattering, and for the mean square of the fluctuation of the length of track for given starting and end points. The fluctuations of the formation of δ-particles in thick layers of matter are considered, as well as the probability distribution of the energy losses in this case, which is found to be of the Gaussian type. The limits of error of the determination of the quiescent mass in measuring the thickness of filters for the absorption of particles of given impulse are found. A.

537.562 3805

Metastable transitions in mass spectra of fifty-six hydrocarbons. BLOOM, E. G., MOHLER, F. L., LENGEL, J. H., AND WISE, C. E. *J. Res. Nat. Bur. Stand., Wash.*, **40**, 437–42 (*June*, 1948)—In the mass spectra of 56 saturated and unsaturated hydrocarbons, all the observable metastable transitions were identified. In 362 cases, there are 32 different transitions involving loss of masses 2, 15, 16, 26, 27, 28, 29, 30, 42 and 44. The occurrence of a metastable transition depends on the intensity of both the initial ion peak and the final ion peak. A.

537.562 3806

The use of retarding potentials with the mass spectrometer. FOX, R. E., AND HIPPLE, J. A. *Rev. Sci. Instrum.*, **19**, 462–6 (*July*, 1948).—In addition to the use of stopping potentials for the study of metastable ions in a mass spectrometer, there are several other important uses, including the study of ions formed with kinetic energy. There are also several interesting phenomena associated with this method which were encountered when this arrangement was first used. These are described and applications of the method are discussed. A.

537.58 : 536.46 : 538.569.2 3807

The measurement of ionisation in a transient flame. ANDREW, E. R., AXFORD, D. W. E., AND SUGDEN, T. M. *Trans. Faraday Soc.*, **44**, 427–37 (*June*, 1948).—The electrical conductivity and the attenuation of 3 cm wavelength electromagnetic radiation in the transient flame or flash produced by firing Service ammunition from a 0·303-in rifle into air were measured. They show a good agreement between each other, both in time and magnitude, as well as with photoelectric measurements of light intensity. Satisfactory agreement is given by calculations of the number of electrons per cm³ from the results of both methods. The application of the Saha equation leads to a value of 2 000°K for the flame temperature, which seems a reasonable value. The main conclusion is that the two methods lead to the same result. A.

537.581 3808

Use of thoria-coated filaments in the mass-spectrometer leak detector. HANLEY, T. E. Note in *Rev. Sci. Instrum.*, **19**, 369 (*May*, 1948).—The W filament used as emitter in the mass spectrograph leak detector has normally a service life of not more than 4 hr, this being due to occasional bursts of gas impairing the normal vacuum in the instrument. A coat of Th brought up cataphoretically was found to increase the life span of the filament at least 10 times.

537.583 : 537.312.5 : 535.215.2/.5 = 3 3809

Variation of thermal electron and photo-electric emission constants of silver oxide-caesium cathodes during activation. SUHRMANN, R., AND DEHMELT, F. W. *Z. Phys.*, **118** (*Nos* 11–12) 677–94 (1942) *In German.*—A surface-oxidized silver cathode was coated with caesium and activated by heating to 180°c, and the emission constants measured (1) during heating and (2) when subjected to light from a tungsten lamp calibrated in black body temperatures. The cathode was then again coated with caesium and the procedure repeated. The different variations of emission constants in the first and second cases are investigated. The apparatus, procedure and results are given in detail. V. W. R.

COSMIC RAYS 537.591

537.591 3810

On the differential energy spectrum of mesons. SHAMOS, M. H., AND LEVY, M. G. Letter in *Phys. Rev.*, **73**, 1396–7 (*June* 1, 1948).—The differential energy spectrum of mesons at sea level has been measured by an absorption technique in which the identity of the particles accepted is established by the detection of the decay electrons. The measurements were made in approximately the same magnetic latitude as the direct measurements of momentum spectrum by Wilson [Abstr. 3170 (1946)], with which complete agreement is shown. J. G. W.

537.591 = 4 3811

Mass of particles in the penetrating component of cosmic rays. PEYROU, C., LHÉRITIER, M., AND LAGARRIGUE, A. *C.R. Acad. Sci., Paris*, **226**, 1271–3 (*April* 19, 1948) *In French.*—In an extension of previous work [Abstr. 2145 (1948)] momentum was measured in the cloud chamber for particles at 1 000 m altitude which, under a thick Pb screen, traversed a further 4·6 cm, but not 8·6 cm, of Pb. The momentum-range data so obtained are considered to be consistent with the presence of particles of two masses of the order 200 m_0, 300 m_0. J. G. W.

537.591 = 82 3812

Slow mesons at heights 900–4 700 m. ZHDANOV, G. B., AND NAOUMOV, A. A. *C.R. Acad. Sci. URSS*,

60 (*No.* 9) 1519–21 (1948) *In Russian.*—Using a coincidence method and apparatus similar to that of Rossi [Abstr. 2933 (1947)], a series of experiments was carried out to explain the part played by secondary slow mesons generated at heights of 4–5 km and present there together with the ends of tracks of high-energy mesons coming from the stratosphere. The first group of experiments gives information on the absorption of slow mesons in the atmosphere and in dense materials. The second group is devoted to investigating the ionization accompanying the mesons. The following are some of the chief results obtained: (*a*) The stream of (vertical) mesons with energy of 15–30 MeV amounts to $0{\cdot}35 \pm 0{\cdot}1\%$ of the intensity of the hard component. (*b*) The stream of mesons with energy up to 160 MeV amounts to 4–7% in relation to all the soft components. (*c*) The general number of mesons which are stopped in 1 g of material $= 0{\cdot}25 \pm 0{\cdot}05$/hr. In view of the absence of any appreciable ionization accompanying the mesons, it is concluded that the generating component and the mesons generated have a single character. W. H.

537.591 : 523.51 3813

The absorption of cosmic radiation in meteorites. BAUER, C. A. Letter in *Phys. Rev.*, **74,** 225–6 (*July* 15, 1948).—The He content of meteorites formed at the absorption of primary cosmic-ray particles in them is shown theoretically to be a function of the meteorite dimensions. Observations are consistent with this, and with the conclusion that it is possible for the whole He content of meteorites to have arisen from cosmic-ray bombardment. J. G. W.

537.591 : 539.18 *see Abstr.* 3946

537.591.1 3814

Evidence for heavy nuclei in the primary cosmic radiation. FREIER, P., LOFGREN, E. J., NEY, E. P., OPPENHEIMER, F., BRADT, H. L., AND PETERS, B. *Phys. Rev.*, **74,** 213–17 (*July* 15, 1948).—The existence of atomic nuclei of atomic number up to ~ 40 has been found at altitudes $>90\,000$ ft by means of the cloud chamber and with photographic emulsions. The primary nature of these particles is established by the rapid decrease of flux with zenith angle at 14 g/cm² depth, and the small number of such particles penetrating to $\sim 60\,000$ ft. The total flux corresponds to the presence of $\sim$ one heavy particle per thousand primary protons. J. G. W.

537.591.1 = 4 3815

Phenomena produced in photographic emulsion by cosmic rays at sea level. MORAND, M., CÜER, P., EDMONT, J., AND MOUCHARAFYEH, H. *C.R. Acad. Sci., Paris,* **226,** 1008–10 (*March* 22, 1948) *In French.*—The identification of particles giving rise to isolated tracks in the emulsion is discussed and the relative numbers of mesons, protons, deuterons, etc., estimated. The numbers of protons relative to stars, their angular distribution and the frequency with which they start in the emulsion are also discussed. The apparent association of proton tracks with stars is noted. The classification of stars is attempted according to whether they arise in light (Na, B, N, C, O) or heavy (Br, Ag) nuclei; the broad characteristics of these categories are given and examples of energy and momentum balance leading to estimates of the mass of the incident initiating particle. J. G. W.

537.591.1 : 537.122 3816

Search for electrons in the primary cosmic radiation. HULSIZER, R. I., AND ROSSI, B. Letter in *Phys. Rev.*, **73,** 1402–3 (*June* 1, 1948).—A cylindrical ionization chamber 5 cm dia. × 15 cm long filled with 6 atmos. purified A was used unshielded and shielded with 2·5 cm Pb at heights up to 20 g/cm² residual pressure in order to detect energetic electrons or photons ($E > 4{\cdot}5 \times 10^9$ eV). Bursts in unshielded chambers are attributed to disintegration stars, the increase under a shield is the upper limit of cascade bursts initiated by electrons or photons. Since the height reached $<$ one cascade unit from the top of the atmosphere, this measurement is approximately an upper limit of primary electrons or photons. It is concluded that energetic electrons are $\gtrsim 1\%$ of the primary rays. J. G. W.

537.591.1 : 539.155.1 = 82 3817

The mass spectrum of varitrons. ALIKHANIAN, A., ALIKHANOV, A., MOROSOV, V., MUSKELISHVILI, G., AND KHRIMJAN, A. *J. Exp. Theor. Phys.*, **18,** 673–702 (*Aug.*, 1948) *In Russian.*—A mass spectrograph, consisting of a powerful permanent magnet and several groups of counters, was constructed for the analysis of masses of the various particle species in the soft and hard components of cosmic radiation. The great dispersion of the spectrometer established the fact that the mass spectrum of the varitrons (discovered in 1946 by Alikhanian, Alikhanov, and Weissenberg) consists of discrete lines. At 3 250 m above sea level there may be more than 12 varieties of varitrons, of different mass and having + ve or − ve charge, $100 \leq m_v \leq 25\,000\, m_e$. The varitrons are also contained in the hard component. The analysis of the impulse spectrum of the hard component yielded that the varitrons recorded by the spectrometer are the result of a disintegration of heavier varitrons stopped by friction in air. The existence of fast protons in cosmic radiation was proved by direct measurements. It can be inferred from the determination of the positive abundance in the spectrum of the hard component that the fast proton fraction in the cosmic rays amounts to $\lesssim 7\%$ of the total intensity. A.

537.591.1 : 539.18 *see Abstr.* 3947

537.591.1 : 539.18 = 3 *see Abstr.* 3948

537.591.15 3818

Variation of penetrating showers with altitude. TINLOT, J. Letter in *Phys. Rev.*, **73,** 1476–7 (*June* 15, 1948).—A counter array with thick Pb shields, designed to detect penetrating showers, was flown at altitudes up to 30 000 ft at geomagnetic latitude 53°N. The counting rates of various counter combinations are recorded and discussed: in particular, twofold coincidences in each of three spaced counter layers separated and covered by 10 cm Pb are shown to decrease exponentially through the atmosphere with an absorption thickness of 120 g/cm². Less rigorous counter combinations are shown to give evidence of disturbing effects, as, for example, multiple electron knock-on by mesons, near sea level. J. G. W.

537.591.15 3819

Penetrating particles in extensive air showers. TREAT, J. E., AND GREISEN, K. I. *Phys. Rev.*, **74,** 414–23 (*Aug.* 15, 1948).—Studies were made at 4 300 and 3 260 m elevation. The particles capable of penetrating 14 cm Pb are about 1 per 30 shower particles at 3 260 m and 1 per 25 at 4 300 m. The number of penetrating particles is reduced by a factor 1·8 when the Pb is increased from 15·5 to 39 cm, and the density of the penetrating particles diminishes by a factor 1·7 between 4 300 and 3 260 m elevation. These facts imply that the penetrating particles are very numerous and have too low average energy to be mesons coming from the top of the atmosphere. Further experiments show that they are not produced multiply in Pb shields above the counters. This fact, together with the independence of their number on the atomic number

of the absorber, seems to indicate they are not produced by photons. A.

537.591.15 3820

The penetrating particles in cosmic-ray showers. I. Heavily-ionizing particles. ROCHESTER, G. D., AND BUTLER, C. C. *Proc. Phys. Soc., Lond.*, **61**, 307–12 (*Oct.*, 1948).—It is shown that whilst almost all the heavily-ionizing particles are protons, a small number are slow mesons. Examples of the local creation of mesons in explosive-type showers are found and are identified as mainly μ-mesons. The results are consistent with the recent discovery of Gardner and Lattes that μ-mesons may be created directly and are not always the disintegration products of π-mesons as suggested by Marshak and Bethe. A.

537.591.15 : 539.185 3821

On the origin of the neutrons associated with the extensive cosmic-ray showers. TONGIORGI COCCONI, V. Letter in *Phys. Rev.*, **74**, 226–7 (*July* 15, 1948).—Neutron detectors (BF_3 counters embedded in a paraffin moderator and used in delayed coincidence) were operated in conjunction with an unshielded array of counters responding to extensive showers. Of two detectors, one was maintained far from absorbing material as a standard, the other was surrounded by layers of matter. The counting rate of this detector in coincidence with the unshielded shower array was increased by a surrounding layer of 4 cm Pb, reduced almost to zero by 25 cm paraffin, and large with 4 cm Pb inside 25 cm paraffin. When 6·5 cm Pb was placed outside this paraffin shield, the neutron rate was not greatly changed, whether or not the 4 cm Pb layer was in place. It is concluded that the neutrons observed are formed by an existing penetrating element in the extensive showers. J. G. W.

537.591.5 3822

Azimuthal effect of cosmic rays at Bombay (magnetic latitude 9·5°N). GILL, P. S., AND VAZE, G. H. Letter in *Phys. Rev.*, **73**, 1395–6 (*June* 1, 1948).—The azimuthal variations of cosmic-ray intensity were measured for a zenith angle of 60°, and the observations are compared with the theoretical curve based on the form of primary spectrum deduced from earlier measurements at Lahore (22°N) and Mexico City (29°N). J. G. W.

537.591.5 3823

The temperature effect on cosmic-ray intensity and the height of meson formation. DUPERIER, A. *Proc. Phys. Soc., Lond.*, **61**, 34–40 (*July*, 1948).—Results obtained in various parts of the world for the effects of ground temperature on cosmic-ray intensity are studied. The great discrepancies are taken as evidence of the instability of the meson. The 12-monthly variation in cosmic-ray intensity, obtained by Forbush [Abstr. 670 (1939)] is accounted for as an effect of meson decay, assuming that the bulk of the penetrating component originates at 7·5 cm Hg pressure level. The results of this assumption appear to confirm that the layer of meson formation lies at or above the 7·5 cm pressure-level. A.

537.591.5 3824

Latitude effect and meson decay. RATHGEBER, H. D. Letter in *Nature, Lond.*, **162**, 303–4 (*Aug.* 21, 1948).—The apparent latitude effect of cosmic-ray intensity at sea level which arises for the variation of height of the layer of maximum meson production is shown to be $\sim \frac{1}{3}$ of the total observed latitude effect. Since an accurate true geomagnetic latitude effect must take account of this effect and also of local meteorological behaviour, simultaneous measurements of cosmic-ray intensity and of the requisite high-atmosphere meteorological data in the same region are necessary. J. G. W.

537.591.5 = 4 3825

Absolute rate of cosmic ray particles at Meudon. ROGOZINSKI, A., AND LESAGE, M. *C.R. Acad. Sci., Paris*, **226**, 1131–3 (*April* 5, 1948) *In French.*—The rate $(2{\cdot}84 \pm 0{\cdot}08)10^{-2}$ particles per cm².sec at an altitude 148 m at latitude 49°N (standard pressure 747 mm) was obtained in an investigation in which particular attention was directed to defining the effective area of the counters used and to eliminating the effects of radioactive contamination of the material of the counter and of its surroundings. The need for a standard procedure for measuring the absolute rate is stressed. J. G. W.

537.591.5 : 539.185 3826

The latitude dependence of neutron densities in the atmosphere as a function of altitude. SIMPSON, J. A., JR. *Phys. Rev.*, **73**, 1389–91 (*June* 1, 1948).—Neutron densities as a function of altitude have been measured at geomagnetic latitudes from 0° to 53°N using BF_3 proportional counters surrounded by paraffin cylinders covered with a Cd sheath (which excludes neutrons below the Cd cut-off energy). Comparable experiments with counters of enriched and normal B are used to exclude the possibility of counts from other causes than neutron capture. The neutron density varies exponentially through the atmosphere with absorption ~ 180 g/cm², and with indication of increasing absorption at high latitudes. The fraction of increase between geomagnetic latitudes 0° and 51° is 2·3 at 45 cm Hg and 3·5 at 15 cm Hg, and thus $>$ that of the vertical soft component or of meson intensity. It is concluded that the neutrons are derived from stars produced by primary protons and their immediate secondary nucleons. J. G. W.

537.591.8 : 539.18 3827

Observations on the production of mesons by cosmic radiation. OCCHIALINI, G. P. S., AND POWELL, C. F. *Nature, Lond.*, **162**, 168–73 (*July* 31, 1948).—The majority of mesons produced in cosmic-ray disintegration stars give rise to a further star at the end of their range, but the majority of mesons entering the emulsion from outside come to rest without the producton of heavy particles. No π-mesons (capable of decay to μ-mesons) are observed to be ejected from stars. Results are consistent with the production of σ-mesons (negative charge) of large nuclear cross-section and not more than 20% μ-mesons in stars, and with failure to observe the corresponding positive (π) mesons because of the additional kinetic energy arising from Coulomb repulsion. No examples have been found of a meson track beginning in the emulsion unaccompanied by at least one heavy charged particle. J. G. W.

537.591.8 : 539.185 3828

Evidence for neutrons associated with the stopping of sea level mesons in lead. SARD, R. D., ITTNER, W. B., III, CONFORTO, A. M., AND CROUCH, M. F. Letter in *Phys. Rev.*, **74**, 97–8 (*July* 1, 1948).—A counter telescope with the lowest layer in anticoincidence is used to select mesons traversing 12·7 cm Pb but stopped in a further 7·0 cm, and is placed over a paraffin moderating block containing a group of slow neutron counters (proportional counters coated within with enriched B, and with efficiency estimated at 10% for room-temperature neutrons). Coincidences are observed between the telescope (twofold coincidence and anticoincidence) and the neutron counter for 80 μsec following the normal counter array discharge. While removal of the stopping (7 cm) Pb layer shows that there are considerable disturbing effects, the experiment is considered to establish the presence of neutrons following the stopping of mesons in Pb. J. G. W.

MAGNETISM 538

538 : 521.038 : 530.1 *see Abstr.* 3583

538 : 525.24 : 530.1 *see Abstr.* 3584

538.113 : 539.156 = 82 3829

Thermodynamical theory of spin-spin relaxation in paramagnetics. SHAPOSHNIKOV, T. G. *J. Exp. Theor. Phys.*, **18**, 533–8 (*June*, 1948) *In Russian.*—The paramagnetic is considered as an ideal one, with magnetism of the pure spin type, and the cases of parallel fields with spin-lattice, and spin-spin relaxation are treated. On the assumption of sufficiently small changes of all variables and brevity of the spin-spin relaxation time as compared with the period of the alternating field, an expression for the complex magnetic permeability is derived. This expression is specialized for the limiting cases of large and small (i.e. by comparison with the reciprocal of the spin-lattice relaxation time) frequencies. A correction is given for the spin-spin relaxation term not quite accurately determined in a previous paper [Gorter, Dijkstra, Groendijk, *Physica*, **7**, 625 (1940)]. It appears that in weak constant fields the basic character of paramagnetic relaxation phenomena is that of spin-spin relaxation. The possibility of the experimental verification of the results is discussed, as well as the prospects of an analogous investigation of the case of a perpendicular field. A.

538.113 : 548.0 3830

Paramagnetism of single crystals of the salts of the iron group of elements at low temperatures. I. The ionic salts of the *F*-state ions Cr^{+++} and Ni^{++}. BOSE, A. *Indian J. Phys.*, **22**, 195–220 (*May*, 1948).—The existing theories of paramagnetic salts and experimental data supporting the crystalline electric field theory of paramagnetic salts are critically discussed. Experimental data on the anisotropies and effective moments of several six-co-ordinated Ni salts at various temperatures, in the range of 300°K and 80°K, attained with a specially devised cryostat, are given and discussed on the basis of the electric field theory. Assuming the electric field in these crystals to be predominantly cubic, with a small superimposed rhombic component, the basic $^3F_4$-state of the Ni^{++} ion splits up into a Stark pattern, consisting of a singlet and two triplets with a mean separation of about 20 000 cm^{-1} due to the cubic field, the components of the triplet being separated to a much smaller extent by the rhombic field. With the aid of experimental data the cubic and rhombic field constants for Ni^{++} salts were calculated, and a detailed consideration of the relative contributions of the various factors towards the total effective magnetic moment was made. The anisotropies and the effective moments and their temperature variations agree with theoretical calculations. The field constants calculated are practically independent of temperature, as is to be expected in view of the strong binding between the Ni^{++} ion and its neighbouring co-ordination group. It is possible to calculate the spin-orbit coupling constant λ for Ni^{++} ion purely from magnetic data and these calculated values agree fairly well with the spectroscopic value. A similar treatment for the Cr^{+++} ion which is in the $^4F_{3/2}$-state leads to the conclusion that here contributions from other sources than the spin moment towards the effective moment are of very much less importance, and in consequence the salts have much less anisotropy and obey Curie's law almost perfectly. A.

538.12 : 621.316.73 3831

A proton-controlled magnetic field regulator. PACKARD, M. E. *Rev. Sci. Instrum.*, **19**, 435–9 (*July*, 1948).—A magnetic field discriminator is described which uses the nuclear induction signal from protons to give a ± 75 V change of d.c. voltage for a ± 0·3 gauss change in magnetic field without using direct coupled amplifiers. An ordinary degenerative current regulator with the addition of information from the magnetic field discriminator will control a magnetic field to within 0·02 gauss for a 10% line voltage change or for normal changes in magnet geometry. The magnitude of the magnetic field is maintained in terms of a frequency, the value of which gives the absolute magnitude of the magnetic field. A.

538.13 : 621.385.833 3832

Ferromagnetic domain observation. MARTON, L. Letter in *Phys. Rev.*, **73**, 1475 (*June* 15, 1948).—Electron microscope photographs formed by electrons scattered from the edge of a thin ferromagnetic specimen show irregular interruptions due, it is supposed, to the fringe field created on domain boundaries. A. E. DE B.

538.224 : 541.66/.67 : 538.27 *see Abstr.* 3836

538.224 : 541.67 3833

Diamagnetism of cuprous compounds. KHANNA, M. L. *J. Sci. Industr. Res.*, **6 B**, 4–8 (*Jan.*, 1947).—Cuprous chloride, bromide, iodide, thiocyanate, cyanide, and oxide have been measured. All are diamagnetic. By subtracting the diamagnetic contribution of the anion in each case, a mean value for the susceptibility of the Cu^+ ion has been obtained as $-16{\cdot}9\times10^{-6}$. The anomalously low values of Cu_2O and $Cu_2(CN)_2$ are discussed. A value of 1·07 Å is derived for the ionic radius of the Cu^+ ion. W. R. A.

538.244.2 : 621.318.3 3834

A mass spectrometer magnet. ANKER, H. S. *Rev. Sci. Instrum.*, **19**, 440–1 (*July*, 1948).—The magnet described with ring-shaped pole pieces and a central core makes a large reduction in weight possible, thus eliminating the main obstacle to the use of π-radian mass spectrometers. A.

538.245/.27 = 4 3835

Variation with temperature of the coercive force of nickel powder. WEIL, L., AND MARFOURE, S. *J. Phys. Radium* (*Sér.* 8) **9**, 358–61 (*Dec.*, 1947) *In French.*—A description is given of the experimental arrangement for the determination of the coercive force at temperatures between − 183°C and the Curie Point of specimens made from Ni powder. Below 0°C the coercive force increases rapidly with decrease of temperature in the same way as the anisotropy constant increases. A. E. DE B.

538.27 : 538.224 : 541.66/.67 3836

Temperature and diamagnetism. II. Diamagnetic susceptibilities of some organic iodides. KHANNA, M. L. *J. Sci. Industr. Res.*, **6 B**, 10–11 (*Jan.*, 1947).—Measurements of diamagnetic susceptibility between 15° and 80° indicate a slight decrease with rise in temperature for ethyl, *n*-propyl, *n*-butyl, *n*-amyl, and phenyl iodides, and for *o*- and *m*-iodotoluenes. It is suggested that the presence of iodine in the iodides may account for the thermo-magnetic effect. W. R. A.

538.27 : 541.67 : 541.128 3837

Susceptibility isotherms for supported copper oxide. SELWOOD, P. W., AND DALLAS, N. S. *J. Amer. Chem. Soc.*, **70**, 2145–7 (*June*, 1948).—Susceptibility isotherms for CuO supported on γ-Al_2O_3, for the reduced catalyst and for related systems have been determined and are compared with X-ray diffraction data and with data on the catalytic activity in the dehydrogenation of *iso*-propyl alcohol. W. R. A.

ELECTROMAGNETISM
ELECTRODYNAMICS 538.3/.5

538.3 : 530.145 *see Abstr.* 3603

538.3 : 530.145 = 82 *see Abstr.* 3604

538.56 : 537.525 = 3 *see Abstr.* 3780

538.566 : 621.396.11 3838

On the propagation of radio waves around the earth. BREMMER, H. *Physica, 's Grav.*, **14**, 301–18 (*June*, 1948) *In English.*—[Abstr. 2837 B (1948)].

538.566.3 : 621.396.1 = 82 3839

Theory of the propagation of electromagnetic waves in a magnetically active medium. GINSBURG, V. L. *J. Exp. Theor. Phys.*, **18**, 487–500 (*June*, 1948) *In Russian.*—The theory developed considers the ionosphere under the influence of the terrestrial magnetic field. The equations of propagation are solved by approximations for the reflecting region of the layer and for the transition region to the layer, where geometrical optics no longer applies. The "trebling" effect of signals is treated by an approximation which is accurate for small angles between the direction of the magnetic field and that of propagation. The question of the active field is looked into somewhat closer, and an expression for the effective collision number, considering the influence of the magnetic field, is obtained by the method of the kinetic equation. A.

538.569.2 : 536.46 : 537.58 *see Abstr.* 3807

538.569.2.047 : 578.088.75 = 4 *see Abstr.* 4080

538.569.3 : 537.226 = 82 *see Abstr.* 3754

538.569.3 : 541.135 : 537.226.2 *see Abstr.* 3756

538.569.3 : 621.317.384 3840

Measurement of absorption in liquids at 1·2 cm and 0·8 cm wavelength using a wave-guide absorption cell operating in the H_{01} mode. POWLES, J. G. *Trans. Faraday Soc.*, **44**, 537–45 (*Aug.*, 1948).—Results are given for the absorption of solutions of a number of polar substances in benzene. The results at 1·2 cm are compared with those obtained by previous workers using alternative methods. A.

MAGNETIC EFFECTS 538.6

538.615 : 535.343.4–14 *see Abstr.* 3691

538.63 : 621.317.44 3841

Two electric generators suitable for the measurement of magnetic intensities and their variations and for other purposes. BARNETT, S. J. *Terr. Magn. Atmos. Elect.*, **51**, 147–62 (*June*, 1946).—[Abstr. 3025 B (1948)].

538.632 : 530.14 = 4 3842

The micro-electronic origin of certain anomalies in the Hall effect. GIÃO, A. *C.R. Acad. Sci., Paris*, **226**, 1177–9 (*April* 12, 1948) *In French.*—A current of micro-electrons [Abstr. 1430 (1948)] could explain certain anomalies in the Hall effect attributable to a current of positive ions. G. J. K.

538.632 : 537.311.33 = 3 3843

Conductivity and Hall-effect in germanium. RINGER, W., AND WELKER, H. *Z. Naturforsch.*, **3a**, 20–9 (*Jan.*, 1948) *In German.*—Measurements were carried out on various Ge alloys containing up to 10% by weight of Cu, and prepared in vacuum. The electron concentration, calculated on the assumption that the material contains only one type of charge carrier, was found to vary from 10^{15} to 10^{22}, and was approximately proportional to the impurity content. Close correlation exists between the resistivity and the Hall constant. The sign of the Hall e.m.f normally indicated excess semi-conduction, but a reversed sign was observed on one occasion. The most pronounced rectifying effects are exhibited by specimens of electron concentration $\simeq 10^{16}$. The electronic mobility is of the order of 2 000 cm sec^{-1}/volts cm^{-1} and a wave-mechanical interpretation of this very high value is given. H. K. H.

538.639 3844

Magnetic resonance absorption in diluted chrome alums. WHITMER, C. A., WEIDNER, R. T., AND WEISS, P. R. Letter in *Phys. Rev.*, **73**, 1468–70 (*June* 15, 1948).—Curves of relative absorption at 9 375 Mc/s against magnetic field are given for pure ammonium chrome alum, and this salt diluted with aluminium ammonium alum, for three crystallographic orientations. The patterns agree with theory, using zero field splittings of 0·143 and 0·100 cm^{-1} respectively. The corresponding values for K alums are 0·13 and 0·091 cm^{-1}. Dilution narrows the peaks, and also reduces their intensity, which is in contradiction to the assumption that line widths are due to spin-spin interaction only. D. H. W.

538.669 : 536.212.2 : 537.32 = 3 *see Abstr.* 3772

538.69 : 541.139 = 4 *see Abstr.* 3997

ATOMIC AND MOLECULAR STRUCTURE 539

539.11 : 530.1 *see Abstr.* 3585

539.11 : 536.2.01 = 4 *see Abstr.* 3729–30

539.11 : 548.0 *see Abstr.* 4016

539.11 : 548.7 = 82 3845

Quantic states and optical transitions of the electron in the polaron and in the colour centre of a crystal. PEKAR, S. I., AND DEIGEN, M. F. *J. Exp. Theor. Phys.*, **18**, 481–2 (*June*, 1948) *In Russian.*—The paper considers polarons, i.e. the self-localized electrons in an ideal ionic crystal, and also the colour centres of the crystal (in alkali-halide crystals), of which a model was developed by one of the authors in previous papers [*J. Exp. Theor. Phys.*, **17** 868 (1947)]. Energy levels, ψ-functions of the electron, and oscillator forces of the optical transitions are computed. A.

539.13 3846

The structure of carbon monoxide. MOFFITT, W. *Proc. Phys. Soc., Lond.*, **60**, 597–8 (*June*, 1948).—Claims CO has electronic structure $(K)(K)(z\sigma)^2(y\sigma)^2(w\pi)^4(x\sigma)^2$, $^1\Sigma^+$ with degenerate π orbitals [contrast Abstr. 447 (1948)]. This accounts for ionization spectra, low dipole moment, and strengthened bond in CO^+, in which one $(x\sigma)$ electron has been removed. D. H. W.

539.13 : 541.5 3847

Electronic structure of fulvene. COULSON, C. A., CRAIG, D. P., AND MACCOLL, A. *Proc. Phys. Soc., Lond.*, **61**, 22–5 (*July*, 1948).—Discrepancies in the results obtained for fulvene by the method of molecular orbitals and the method of valence-bond structures are discussed, and various possible structures for the molecule are studied. Further experimental work is needed for further progress. L. S. G.

539.13 : 541.62 3848

The *para–ortho* hydrogen conversion by paramagnetic substances in solution. CLAEYS, Y., BAES, C. F., JR., AND WILMARTH, W. K. Letter in *J. Chem. Phys.*, **16**, 425–6 (*April*, 1948).—Wigner [*Zeits. f. phys. Chem. B*, **23**, 28 (1933)] predicted that the rate of the *para–ortho* conversion $\propto$ (distance of closest approach of the hydrogen molecule and the paramagnetic ion)^6. The present writers, however, have investigated this relationship by studying the *para*-hydrogen conversion by complex paramagnetic ions, whose radii can be varied at will.

The investigation is not complete, but present work indicates that the process is not so sensitive to variation of the radius as the Wigner theory predicts. H. H. HO.

539.132 3849

Coupling of electron spins in rotating polyatomic molecules. HENDERSON, R. S., AND VAN VLECK, J. H. Letter in *Phys. Rev.*, **74**, 106–7 (*July* 1, 1948).—A theory is given of the fine structure observed in the rotational energy levels of molecules possessing an odd number of electrons. A small perturbing term of the form $A(\mathbf{L} \cdot \mathbf{S})$ is associated with that part of the molecular Hamiltonian which represents rotational energy. This term is a highly off-diagonal matrix giving a 2nd-order correction consisting of two parts. In the case of Cl dioxide, only the first part, which has its origin in cross-terms connecting the spin coupling energy with rotational distortion of the orbital motion, is present, and the theoretical results are in very good agreement with experiment. L. P.

539.132 3850

Effect of large quadrupole interactions on nuclear radiofrequency spectra at twice Larmor frequency. RAMSEY, N. F. *Phys. Rev.*, **74**, 286–91 (*Aug.* 1, 1948).—Previous work [Abstr. 1922 (1945)] on the effect of a nuclear electrical quadrupole moment on the radiofrequency absorption spectrum of a heteronuclear diatomic molecule in a magnetic field is extended to a case in which the electrical quadrupole interaction energy is so large that even in magnetic fields of several thousand gauss the magnetic interaction energies are small compared to the electrical quadrupole interaction energy. In this case it is shown theoretically that for a spin of $\frac{3}{2}$ there are certain circumstances under which a maximum of absorption will occur at double the Larmor frequency instead of at the Larmor frequency and will have a field and molecule dependence similar in many ways to a resonance at the Larmor frequency. This result has the important implication that special care must be used in identifying the radiofrequency resonance absorption spectra or an error of a factor of 2 in the value of a nuclear magnetic moment can easily be made. The approximate shape and intensity of the radiofrequency absorption spectrum under these circumstances is calculated in order that a comparison of the theoretical shapes and intensities with the experimental ones can be used as a means of recognizing if an absorption is a double Larmor frequency one. A.

539.132 : 535.343–14 3851

Microwave determination of the molecular structures and nuclear couplings of the methyl halides. GORDY, W., SIMMONS, J. W., AND SMITH, A. G. *Phys. Rev.*, **74**, 243–9 (*Aug.* 1, 1948).—Accurate measurements on the pure rotation spectra of CH_3Cl, CH_3Br and CH_3I were made with multiples of a 10 Mc/s frequency. The measurements allowed a complete determination of the structures of these molecules. The nuclear quadrupole couplings were also found. Second-order effects in the hyperfine structure were observed for CH_3Br and CH_3I. A.

539.132 : 535.343.4–14 *see Abstr.* 3692

539.132 : 536.75 3852

Thermodynamic properties of the internal rotator. Double minimum with attractive forces. HALFORD, J. O. *J. Chem. Phys.*, **16**, 560–4 (*June*, 1948).—In this application of the theory given before [Abstr. 2608, 3592 (1947), 3323 (1948)], the potential energy has two maxima at the same height and two minima at different heights. The entropy is lower than that of the system of two equal potential valleys or that for a single valley, and can be lower than the former by as much as $R \ln 2$ when the potential barriers are high. This decrease tends to disappear in the region of close approach to free rotation, when the barriers are lower than *RT*. For very high potential barriers, if one of two equal minima is raised, the system acquires the properties of a simple harmonic oscillator. A.

539.133 : 535.343.4.14 3853

Interatomic distances and nuclear quadrupole couplings in ClCN, BrCN, and ICN. SMITH, A. G., RING, H. SMITH, W. V., AND GORDY, W. *Phys. Rev.*, **74**, 370–2 (*Aug.* 15, 1948).—The following nuclear and molecular constants were obtained from microwave measurements of the pure rotational spectra of ClCN ($J = 2 \rightarrow 3$ transition), BrCN ($J = 3 \rightarrow 4$), and ICN ($J = 4 \rightarrow 5$). The moments of inertia from the ground vibrational states are, in g-cm^2 $\times 10^{-40}$: for $Cl^{35}C^{12}N^{14}$, $140{\cdot}5_{11}$; for $Cl^{35}C^{13}N^{14}$, $141{\cdot}2_{45}$; for $Cl^{37}C^{12}N^{14}$, $143{\cdot}4_{80}$; for $Cl^{37}C^{13}N^{14}$, $144{\cdot}2_{83}$; for $Br^{79}C^{12}N^{14}$, $203{\cdot}6_{21}$; for $Br^{81}C^{12}N^{14}$, $204{\cdot}7_{86}$; for $Br^{79}C^{13}N^{14}$, $205{\cdot}9_{64}$; for $Br^{81}C^{13}N^{14}$, $207{\cdot}1_{72}$; for $I^{127}C^{12}N^{14}$, $260{\cdot}0_{99}$; and for $I^{127}C^{13}N^{14}$, $264{\cdot}0_{72}$. The interatomic distances in Å for the ground vibrational states are $d_{CCl} = 1{\cdot}630$, $d_{CN} = 1{\cdot}163$, for ClCN; $d_{CBr} = 1{\cdot}789$, $d_{CN} = 1{\cdot}160$, for BrCN; and $d_{CI} = 1{\cdot}995$, $d_{CN} = 1{\cdot}159$, for ICN. Quadrupole couplings in Mc/s evaluated from the hyperfine structure are: for Cl^{35}, $-83{\cdot}5$; for Cl^{37}, $-65{\cdot}0$; for Br^{79}, 686; for Br^{81}, 573; and for I^{127}, $-2\,420$. A.

539.133 : 536.666 : 541.115 3854

Heats of dissociation of cyanogen. GLOCKLER, G. *J. Chem. Phys.*, **16**, 600–1 (*June*, 1948).—Some arguments are presented which would indicate that the heat of dissociation of C_2N_2 into two CN radicals is 5·52 eV and the heat of dissociation of CN radicals into atoms is 6·52 eV. A.

539.133 : 536.666 : 541.115 3855

Heats of dissociation of the N_2 molecule and the NH radical. GLOCKLER, G. *J. Chem. Phys.*, **16**, 602–4 (*June*, 1948).—A comparison made between certain radicals and molecules would indicate that the heat of dissociation of nitrogen molecules is 9·764 eV and the heat of dissociation of NH radicals into atoms is 3·74 eV. A.

539.133 : 536.666 : 541.115 3856

The heat of dissociation of nitric oxide. GLOCKLER, G. *J. Chem. Phys.*, **16**, 604–8 (*June*, 1948).—The heat of dissociation of nitric oxide is considered to be 6·49 eV on the basis of a comparison of the series CO, NO, O_2, OF, its band spectrum, and its photo-chemical dissociation. Appearance potentials of N^+, O^+, and O^- can be interpreted on this basis. A.

539.133 : 541.57 *see Abstr.* 4010

539.133 : 541.6 3857

The geometry of CH_3X molecules. SKINNER, H. A. Letter in *J. Chem. Phys.*, **16**, 553–4 (*May*, 1948).—A critical discussion of the recent work on the molecular dimensions of the methyl halides shows there is no positive evidence that the CH_3 group is flatter than in a regular tetrahedron, although a small distortion of a few degrees is not outside the experimental errors. D. H. W.

539.152 3858

Some observations concerning the energy of nuclei. GLUECKAUF, E. *Proc. Phys. Soc., Lond.*, **61**, 25–33 (*July*, 1948).—It is shown that the α-binding energy as a function of the number of neutrons and protons exhibits sharp fluctuations at fairly regular intervals. There is evidence that this is caused by discontinuous changes in the density and radius of the nuclei. A study is made of the energies of β-decay of isobaric nuclei in the region

of the radioactive elements. Nuclei of odd mass-number have a slightly higher binding energy for even proton number, Z, than for odd Z. A.

539.152 : 535.14 3859

Theory of elliptically polarized photons. ARAKI, G. *Phys. Rev.*, **74**, 472–9 (*Aug.* 15, 1948).—The unitary transformation from linearly to elliptically polarized states of photons is determined in a scheme of second quantization. A general formula for the probability of an emission of light from an atom is deduced on the basis of the Dirac electron theory so as to include both a magnetic dipole and an electric quadrupole term. The general theory is applied to electric dipole and quadrupole and magnetic dipole spectral lines. Polarization states of the Zeeman components corresponding to all combinations of magnetic and orbital magnetic quantum numbers of an atom are completely determined for an arbitrary given direction of an observation on the basis of quantum mechanics. A.

539.152 : 537.122 3860

The magnetic moment of the electron. KUSCH, P., AND FOLEY, H. M. *Phys. Rev.*, **74**, 250–63 (*Aug.* 1, 1948).—A comparison of the g_J values of Ga in the $^2P_{3/2}$ and $^2P_{\frac{1}{2}}$ states, In in the $^2P_{\frac{1}{2}}$ state, and Na in the $^2S_{\frac{1}{2}}$ state was made by a measurement of the frequencies of lines in the h.f.s. spectra in a constant magnetic field. The ratios of the g_J values depart from the values obtained on the basis of the assumption that the electron spin gyromagnetic ratio is 2 and that the orbital electron gyromagnetic ratio is 1. Except for small residual effects, the results can be described by the statement that $g_L = 1$ and $g_S = 2(1{\cdot}00119 \pm 0{\cdot}00005)$. The possibility that the observed effects may be explained by perturbations is precluded by the consistency of the result as obtained by various comparisons and also on the basis of theoretical considerations. A.

539.152.1 3861

On closed shells in nuclei. MAYER, M. G. *Phys. Rev.*, **74**, 235–9 (*Aug.* 1, 1948).—Experimental facts are summarized to show that nuclei with 20, 50, 82, or 126 neutrons or protons are particularly stable. A.

539.152.1 3862

Phenomenological theory of exchange currents in nuclei. SACHS, R. G. *Phys. Rev.*, **74**, 433–41 (*Aug.* 15, 1948).—On the assumption that the interaction between nuclear particles involves a space exchange operator, it is shown that an addition must be made to the conventional current density for the nucleons in order to establish the equation of continuity within the nucleus. A general expression is found for this exchange current and the corresponding exchange magnetic moment. This theory has application to the calculation of magnetic moments of nuclei and to the calculation of transition probabilities for the absorption and emission of radiation by nuclei. Here, application is limited to the exchange moments of H^3 and He^3. It is found that the exchange moments are 6 or 7 times too small to account for the observed moments. In view of results obtained by Villars [Abstr. 1023 (1948), 3284 (1947)], it is concluded that the important contributions to the magnetic moment are directly related to the properties of the meson field which describes the nuclear interaction, so the exchange moment may be of use for obtaining direct information concerning the nature of this field. A.

539.152.1 : 530.14 *see Abstr.* 3595

539.152.1 : 530.145.6/.7 = 3 *see Abstr.* 3611

539.152.1 : 535.332 : 530.145.61/.62 = 3 3863

Theory of hydrogen fine [hyperfine] structure. SOMMERFELD, A. *Z. Phys.*, **118** (*Nos* 5–6) 295–311 (1941) *In German.*—Using the Schrödinger equation and idealizing nuclear forces by an infinitely steep potential barrier the author previously explained the supposed shift of the 25 terms in the hyperfine structure of H. However in the Dirac theory the potential function must be continuous. The S and $P_{\frac{1}{2}}$ terms of the hyperfine structure are then found to be practically unaffected by the nuclear field. Schrödinger's method, assuming a continuous potential function, and the perturbation method both corroborate this. The author therefore doubts the existence of supposed hyperfine structure anomalies until further evidence appears. V. W. R.

539.152.1 : 537.122 3864

Erratum: Does the electron have an intrinsic magnetic moment? BREIT, G. *Phys. Rev.*, **73**, 1410–11 (*June* 1 1948).—The correction of a mathematical error in the author's paper [Abstr. 691 (1948)] now brings his work into agreement with that of Schwinger [Abstr. 143 (1948)]. W. E. D.

539.152.1 : 539.155.2 = 4 3865

On the periodicity of certain characteristic properties of atomic nuclei. CHANSON, P. *C.R. Acad. Sci., Paris*, **226**, 997–8 (*March* 22, 1948) *In French.*—The number of isotopes of the elements have maxima at atomic numbers 20, 36, 54, 82 and minima at 27, 45, 73. Elements with atomic number differing by 18 in the lower range and 28 in the upper range have similar properties with respect to isotopes. G. J. K.

539.152.1 : 539.163.2 *see Abstr.* 3899

539.152.1 : 539.175 : 530.145 = 4 *see Abstr.* 3605

539.152.2 : 535.343.4–14 *see Abstr.* 3693

539.153 : 523.87 *see Abstr.* 3579

539.153 : 535.338.332 *see Abstr.* 3682

539.153 : 551.594.51 : 535.338.1 *see Abstr.* 3680

539.153.4 3866

Non-product wave function for a negative ion. CONWELL, E. *Phys. Rev.*, **74**, 268–76 (*Aug.* 1, 1948).—A departure from the Hartree type wave function was attempted along lines found successful for H^-. The basic ψ taken was a product of the nine Hartree one-electron functions for O^- multiplied by a term including r_{ij} terms representing what were considered the most important electron interactions—those between 4 of the $2p$ electrons and a fifth, arbitrarily considered the added one. Since there are 6 possible configurations for 5 equivalent $2p$ electrons, the actual Ψ was taken as a linear combination of the 6 possible ψ's of the type described. Minimizing the energy with respect to the coefficients in this linear combination leads to the same type of secular equation as is obtained in perturbation theory. It is shown that only the diagonal elements of the determinant are non-vanishing, and one of these is chosen for the evaluation of the energy. The electron affinity to be obtained using this wave function is considerably greater than the value obtained earlier [Abstr. 3894 (1939)]. A.

539.153.4 3867

Wave functions for H^- obtained by variation method. CONWELL, E. *Phys. Rev.*, **74**, 277–8 (*Aug.* 1, 1948).—A wave function for H^- of the form $\psi = f_1(r_1)f_2(r_2)(1 + cr_{12})$ was set up. For a given value of the parameter c, determination of the functions f_1 and f_2 which will make the energy a minimum leads to a pair of simultaneous integro-differential equations for f_1 and f_2 with the energy as a parameter. Numerical integration of these for different values of the energy and c was carried out for the cases: (1) $f_1 = f_2$, and (2) f_1 taken as the function e^{-r}, the ground state of neutral hydrogen. Neither of these

gave as good a value of the electron affinity as has been obtained with previously investigated analytic functions. A.

539.154.2 3868

Physical periodicity of the periodic table of the elements in the light of statistical theory. HERDAN, G. Letter in *Nature, Lond.*, **162**, 215–16 (*Aug.* 7, 1948).—Correlogram analysis performed on the values of atomic volume, melting point, compressibility, ionization potential, and density of the first 60 elements show a period of length 18 atomic numbers, and, in addition for melting point and ionization potential, a superimposed period of numbers. These two properties have more of a dynamic character than the others.

539.155.1 : 537.591.1 = 82 *see Abstr.* 3817

539.155.2 3869

The isotopes Os^{185} and Os^{193}. KATZIN, L. I., AND POBERESKIN, M. *Phys. Rev.*, **74**, 264–7 (*Aug.* 1, 1948).—The half-life of Os^{193} is shown to be 15·0 days, decay being by emission of a β-particle with range less than 35 mgm/cm² of Al (energy not more than 0·165 MeV). A highly converted γ-ray of about 0·13 MeV energy is probably emitted at each disintegration, producing X-rays in large abundance. Os^{185} decays by orbital capture with a half-life of 97 days. A γ-ray of 0·75 MeV is probably emitted at each event. The relative cross-sections for pile (slow) neutron capture of the isotopes Os^{184}, Os^{190}, and Os^{192} were estimated as 80 : 3·5 : 1, on the basis of measurements on the daughter activities. A.

539.155.2 3870

An isotopic abundance rule. CHACKETT, K. F., AND MARTIN, G. R. Letter in *Proc. Phys. Soc., Lond.*, **61**, 197–8 (*Aug.*, 1948).—It is suggested that the exceptions to the rule requiring even-odd nuclei to have at least one even-even neighbour of greater abundance are accountable in terms of long-period radioactivity, either in the neighbours or in the parent element yielding the even-odd nucleus considered. A. P. F.

539.155.2 : 519.2 = 3 3871

The statistics of isotope distribution with condensed particles. HOLLECK, L. *Z. Phys.*, **118** (*Nos* 5–6) 340–2 (1941) *In German.*—Partial isotope separation using density variations of condensed particles was previously mathematically investigated by the author [*Z. Phys.*, **116**, 624 (1940)]. In the paper, the statistical probability of isotope separation by this process is investigated. An integral calculation for determining the probable occurrence of condensed particles within a given isotope range is detailed. V. W. R.

539.155.2 : 539.152.1 = 4 *see Abstr.* 3865

539.155.2 : 539.17 : 535.338.4 *see Abstr.* 3684

539.156 : 538.113 = 82 *see Abstr.* 3829

RADIOACTIVITY . NUCLEAR DISINTEGRATION NUCLEAR PARTICLES 539.16/.18

539.16.08 3872

The recovery of the Wilson cloud chamber working with constant final volume. ENDT, P. M. *Physica, 's Grav.*, **14**, 97–103 (*April*, 1948) *In English.*—The temperature in the middle of the chamber after an expansion with constant final volume is calculated by the method of the Laplace transform, and compared with an earlier calculation [Abstr. 3626 (1939)]. The chamber operates best with constant final pressure after the expansion but with constant final volume after the compression. The recovery time is calculated for this case. A.

539.16.08 3873

A study of expected loss rates in the counting of particles from pulsed sources. WESTCOTT, C. H. *Proc. Roy. Soc. A*, **194** (*No.* 1039) 508–26 (1948).—The use in nuclear physics of accelerators giving a pulsed output leads to difficulties when electrical methods are used for detecting the particles produced. The counting losses due to the finite resolving time of the counting system are enhanced by reason of the pulsed nature of the source, and may become considerable unless the counting speed is kept quite low. Some calculations on the loss rates to be expected are presented. It is desirable for the resolving time of the counting system, i.e. the dead time following each count, to be much shorter than the pulse length of the accelerator, but since this is itself usually only a few μsec, this condition is not easy to achieve. If the dead-time is greater than the duration of the accelerator pulse, the calculations are relatively easy but the losses may be high. Calculations for intermediate cases show that the losses can be estimated fairly accurately, and results of practical value can be obtained up to fairly high counting speeds when the dead-time is as high as 40% of the pulse length. The accuracy with which the loss can be calculated will usually be limited by the uncertainty in our knowledge of the shape of the output pulse of the accelerator and of the exact length of the dead-time of the counting arrangement. A.

539.16.08 3874

Analysis of spurious counts in Geiger counters. PUTMAN, J. L. *Proc. Phys. Soc., Lond.*, **61**, 312–19 (*Oct.*, 1948).—A method is described by which the intervals between successive pulses may be divided into size classes. The rate of arrival of intervals whose length is between t and $t + \delta t$ is measured, where t is variable and δt is a preset period, small compared with t. The method is applied to the study of Geiger counter pulses for argon-alcohol counters. By examining the deviation of the pulse interval distribution from random laws, the number and time distribution of spurious counts is deduced for various potentials applied to the counter. It is found that almost all the spurious counts occur during the recovery period of the counter. They may be eliminated by the use of an external quenching circuit which applies an artificial dead time of the order of 400 μsec to the counter. A.

539.16.08 3875

Self-delayed coincidences with scintillation counters. DEBENEDETTI, S., MCGOWAN, F. K., AND FRANCIS, J. E., JR. Letter in *Phys. Rev.*, **73**, 1404–5 (*June* 1, 1948).—With a scintillation counter as the detecting device, a successful attempt was made to measure the ½-life of Hf^{181} using the method of self-delayed coincidences [Abstr. 960 (1947)]. The value obtained was in good agreement with the results of earlier determinations (22 μsec). An anthracene crystal and photo-multiplier tube working at room temperature were employed, the results indicating the high efficiency of this type of counter. In addition, the very short dead time suggests the possibility of measuring much shorter time intervals. R. W. P.

539.16.08 3876

The use of anthracene as a scintillation counter. BELL, P. R. Letter in *Phys. Rev.*, **73**, 1405–6 (*June* 1, 1948).—Transparent crystalline slabs of naphthalene and anthracene were prepared and the latter behaved much better (at room temperature) as a scintillation counter. The γ-rays from a Co^{60} source produced pulses 3 × bigger in anthracene than in naphthalene and, further, if a pulse selector was set to admit only 10 background

counts/sec the anthracene was 93% efficient and the naphthalene only 63%. (Extrapolation to zero pulse height, however, gave 100% efficiency for both materials.) The efficiency of the anthracene to C^{14} β-rays (max. energy 154 MeV) was comparable with that for a thin mica window Geiger counter. Po α-particles gave pulses $5\times$ larger in anthracene than in naphthalene. The fast neutrons from a Po–α–Be neutron source were counted with 10% efficiency for a 1 cm thick anthracene sample, the pulses being $>$ those due to the Co^{60} γ-rays. R. W. P.

539.16.08 3877

Alkali halide scintillation counters. HOFSTADTER, R. Letter in *Phys. Rev.*, **74**, 100–1 (*July* 1, 1948).—A sample of NaI crystals (8·0 g) with Tl impurities, enclosed in quartz, was shown to give much larger pulses when exposed to Ra γ-rays and placed close to a photomultiplier than a clear piece of naphthalene of comparable size. Oscillographic records and a differential bias curve for the pulses are given to illustrate this point. It appeared that with NaI the light flashes were emitted in 1 μsec or less. Successful experiments have also been made using KI. A neutron counter using a Li halide seems a reasonable possibility R. W. P.

539.16.08 = 3 3878

Quantitative determination of radioactive solutions. BECKER, A., AND SCHAPER, I. *Z. Phys.*, **118** (*Nos* 5–6) 357–74 (1941) *In German.*—Describes an exact and rapid method for quantitative determination of Ra, MTh and RaTh in radioactive solutions, when present in traces equivalent to less than 0·01 mg Ra. It makes use of emanation and γ-ray measurements and the apparatus and procedure method is described in detail. Tests prove the efficacy and accuracy of the method. V. W. R.

539.16.08 = 4 3879

Scintillation counter for atomic particles. KAHAN, T., DEBIESSE, J., CHAMPEIX, R., AND BIZOT, H. *J. Phys. Radium* (*Sér.* 8) **9**, 25–6 (*Jan.*, 1948) *In French.*—Counting of nuclear particles by detection of the scintillations of a fluorescent screen with a photo-cell and electron multiplier is described. The transmutation B(n, α) and Li (n, α) have been detected in this way. A.

539.16.08 : 535.376 = 3 *see Abstr.* 3714–15

539.16.08 : 537.311.35 *see Abstr.* 3767

539.16.08 : 537.542 3880

Geometric factors underlying coincidence counting with Geiger counters. NEWELL, H. E., JR. *Rev. Sci. Instrum.*, **19**, 384–9 (*June*, 1948).—The coincidence rate of a perfectly efficient 2-counter telescope embedded in an isotropic field of radiation is obtained in terms of the radiation intensity and the effective dimensions and separation of the counters comprising the telescope. The counting rate may be located between an upper and a lower bound which mostly differ by only a few %. The formulae are also presented graphically, enabling calculation of the ratio of coincidence rate to radiation intensity once the effective dimensions and separation of the two counters are known. A.

539.16.08 : 537.542 *see Abstr.* 3800–3

539.16.08 : 539.164.75 3881

The absorption factor in counting alpha rays from thick mineral sources. NOGAMI, H. H., AND HURLEY, P. M. *Trans. Amer. Geophys. Un.*, **29**, 335–40 (*June*, 1948).—The total measured α-emission from a thick layer of powdered sample of each of a number of minerals and rocks of known U and Th content agreed well with the emission predicted for the samples on the basis of a source absorption proportional to the square root of the atomic weight of the elements comprising the source. Thus, the measurement of combined U and Th in mo minerals and rocks may be made by the simple count α-rays above a thick layer of the sample, and the applic tion of the appropriate absorption factor. Counti equipment particularly suitable for the range of activ of common rocks is described which will count all of t α's emitted above the plane of the source having residual range greater than a specified amount, th requiring no calibration.

539.16.08 : 621.318.572 38

A new scale-of-ten recorder. WELLS, F. H.; LOWT R. D. Letters in *J. Sci. Instrum. Phys. Ind.*, **25**, 2 (*June*, 1948).—Correspondence. [See Abstr. 607 (1948)].

539.162 : 539.163.4 = 3 *see Abstr.* 3900

539.163 38

Stability of Os^{187} against K-capture. SELIGER, H. H AND BRADT, H. L. Letter in *Phys. Rev.*, **73**, 1408 (*June* 1, 1948).—The counting rates produced by metal Os in geometrically similar counters, filled with A and X respectively, were compared. No differential effect d to X-rays following K-capture was observed, and t $\frac{1}{2}$-life for the transition Os $\rightarrow$ Re was deduced to $\geqslant 4\times10^{12}$yr [cf. Abstr. 1898 (1948)]. A. P.

539.163 38

Note on the "Natural radioactivity of rhenium." SUGARMAN, N., AND RICHTER, H. Letter in *Phys. Rev.* **73**, 1411–12 (*June* 1, 1948).—Confirmation that the so β-radiation from Re was not due to a possible contamina tion with natural Tc ($Z=43$) was obtained by carryin out a chemical separation, the efficacy of which wa tested by adding Tc tracer to a Re sample. No reductio of specific activity relative to untreated Re [Abstr. 189 (1948)] could be detected. A. P.

539.163 38

The isotopic constitution of praseodymium and neody mium. INGHRAM, M. G., HESS, D. C., JR., AND HAYDEN R. J. Letter in *Phys. Rev.*, **74**, 98–9 (*July* 1, 1948).— Mass spectrometer studies of rare earths [Abstr. 70 1626 (1948)] have been continued. Pr has a single know stable isotope (141); upper limits for possible stabl isotopes from 138 to 145 are given, and vary fro $<0\cdot001\%$ for 145 to $<0\cdot010\%$ for 142. Relativ abundances are given for the seven known stable isotope of Nd, and upper limits are given for the abundance o other possible isotopes. T. G. P

539.163 38

Decay scheme of ^{181}Hf. BENEŠ, J., GHOSH, A. HEDGRAN, A., AND HOLE, N. *Nature, Lond.*, **162**, 261 (*Aug.* 14, 1948).—β-spectrum measurements indicat γ-rays of energy 342, 128 and 472 keV [Abstr. 343 (1948)]. γ–γ coincidences were obtained with a tim delay of 10 μsec in one channel, even with filtering of th soft 128 keV γ-ray and X-radiation, thus proving tha the metastable state does not follow the β-disintegratio directly [Abstr. 960 (1947)]. It is suggested that th γ-rays are emitted in order as given above. R. W. H

539.163 38

Beta spectrum of tritium. CURRAN, S. C., ANGUS, J AND COCKCROFT, A. L. Letter in *Nature, Lond.*, **162** 302–3 (*Aug.* 21, 1948).—A proportional counter (argon methane filling, 1 atmosphere pressure), linear amplifie and photographic recorder with cathode-ray tube wer used to obtain a relative measure of the energy of th H^3 β-particles above 500 eV, the counter containin sufficient tritium gas to give 5 000 counts per minut An analysis of 40 000 pulses gave an upper β-ray energ limit of $16\cdot9\pm0\cdot3$ keV the distribution near this lim

uggesting a neutrino mass $< \frac{1}{300}$ of the electronic mass. The maximum in the distribution curve occurs at ~ 2·5 keV, and is rather wider than the maximum of the appropriate theoretical Fermi curve (which occurs at ~ 2 keV). As there is no evidence of a γ-radiation, it s possible to write the mass equation (atomic) as $H^3 - He^3 = 0{\cdot}000018$. R. W. P.

539.163.1 : 539.165.2 = 4 3888

The distribution of the periods and maximum energies of β-ray emitters. Nahmias, M.-E. *C.R. Acad. Sci., Paris*, **226**, 1267–9 (*April* 19, 1948) *In French.*—A distribution curve is given for the periods of some 450 radio-elements, advantage being taken of the best available data [Abstr. 1303 (1948)]. This curve shows a single maximum at $\log T \sim 3{\cdot}5$. A similar distribution curve n maximum energies for 300 radio-elements is given, and this shows a single maximum at $E = 1{\cdot}6$ MeV $+ m_0c^2 =$ 2·1 MeV. The difficulties are considered which arise in relating these two distributions, account being taken of the Sargent diagram. R. W. P.

539.163.2 3889

A rapid method for the determination of the maximum energies of β-emitters with simple spectra. Yaffe, L., and Justus, K. M. Letter in *Phys. Rev.*, **73**, 1400–1 (*June* 1, 1948).—The increase in counting rate due to back scattering was measured when a metal foil (Pb or Ag, 55 mg/cm²) was placed directly behind a thin-layered β-ray source (mounted on Formvar 50 mg/cm²), placed near an end-on Geiger counter (mica window 2·8 mg/cm²). Beta-ray emitters used were C^{14}, S^{35}, P^{32}, I^{131}, Co^{60}, Rh^{106} (all simple spectra except Rh^{106}). A plot of the increase in counting rate against the maximum energy of the β-emitter gave a smooth curve. Once this empirical curve is determined it can be used to make rapid estimates of the maximum energies of other β-emitters with simple spectra. R. W. P.

539.163.2 3890

Internal conversion in tungsten and platinum. Scherb, M. V., and Mandeville, C. E. Letter in *Phys. Rev.*, **73**, 1401–2 (*June* 1, 1948).—The β–β coincidence rate as a function of Al absorber thickness was measured for the disintegration of Ta^{182}. The absorption curve appeared roughly exponential in form, but reached zero at 0·0235 g/cm², thus indicating a maximum conversion electron energy of 0·135 MeV. The β–β coincidence rate for the disintegration of Ir^{192} was reinvestigated [see Abstr. 1053 (1948)]. This information, together with the β–γ coincidence rate, gave an estimated total conversion coefficient of 32 ± 3%. R. W. P.

539.163.2 3891

Beta- and gamma-spectra of Cs^{137}. Townsend, J., Owen, G. E., Cleland, M., and Hughes, A. L. Letter in *Phys. Rev.*, **74**, 99–100 (*July* 1, 1948).—Beta-ray spectroscope investigations have shown that the 33-yr Cs^{137} isotope produces a simple β-ray spectrum with an end-point at 0·550 MeV energy and a single γ-ray of 0·663 MeV energy and estimated internal conversion coefficient of 0·12. The use of Cs^{137} as a γ-ray standard is suggested. R. W. P.

539.163.2 3892

On the high energy part of the K^{40} β-spectrum. Franchetti, S., and Giovanozzi, M. Letter in *Phys. Rev.*, **74**, 102–3 (*July* 1, 1948).—Investigations of this made by means of the cloud chamber method gave a value of 1·7 ± 0·1 MeV for the upper limit. This result shows that it is possible to associate the K^{40} 1·5 MeV γ-ray with the β-disintegration of K^{40}, the required low energy partial spectrum at (1·7 − 1·5) MeV = 0·2 MeV probably corresponding to one reported by Bocciarelli [Abstr. 3784 (1932)]. Other workers had put the end point of the β-spectrum at such a low value that the γ-ray had previously been assumed to be associated with a *K*-capture process [see Hirzel and Wäffler, *Helv. Phys. Acta*, **19**, 216 (1946) and Dželepow, Kopjova and Vorobjov, Abstr. 2363 (1946)] A cascade process is not possible because of the relative numbers of β- and γ-emissions. R. W. P.

539.163.2 3893

Energy of the Be^7 gamma-ray. Zaffarano, D. J., Kern, B. D., and Mitchell, A. C. G. Letter in *Phys. Rev.*, **74**, 105–6 (*July* 1, 1948).—A summary is given of the results of earlier workers in the determination of the energy of the excited state of the Li^7 nucleus, some of which disagree. In this new determination Be^7, produced in the reaction $Li^6(d, n)Be^7$, and decaying as $Be^7(K, \gamma)Li^7$, was used in a magnetic lens spectrometer with a Cu–Pb radiator. The photoelectrons produced by the γ-ray were compared in energy with Cu annihilation radiation photoelectrons for calibration purposes. The best value for the γ-ray energy appeared to be 474 ± 4 keV. R. W. P.

539.163.2 3894

Shape of the positron spectrum of Cu^{61}. Cook, C. S., and Langer, L. M. Letter in *Phys. Rev.*, **74**, 227–8 (*July* 15, 1948).—A high resolution, 40 cm radius, shaped-field magnetic spectrometer was used for the study of the positron spectrum of a 0·1 mg/cm² source of Cu^{61} with a backing of 0·02 mg/cm² Zapon. The extrapolated Fermi end-point was 1·205 ± 0·005 MeV. Large deviations from the Fermi plot for an allowed transition were observed at low energies. The ratio of the observed number of positrons per unit momentum interval to that predicted by the Fermi theory is plotted as a function of the positron energy and compared with data obtained in an earlier investigation [Abstr. 1903 (1948)] with a Cu^{64} source. The deviations from the theoretical distributions are not the same for the two isotopes. R. W. P.

539.163.2 3895

The radioactive decay constants of K^{40} as determined from the accumulation of Ca^{40} in ancient minerals. Ahrens, L. H., and Evans, R. D. *Phys. Rev.*, **74**, 279–86 (*Aug.* 1, 1948).—New measurements of the rate of emission of γ-ray energy by K^{40} give 4·9 ± 0·1 MeV/sec. g of K. Thus the minimum value of the probability of electron capture in K^{40} is $\lambda_e = 0{\cdot}062 \times 10^{-9}$ yr^{-1}. Spectrochemical analysis of 4 samples of lepidolite known to be $2{\cdot}1 \times 10^9$ years old, as well as 22 younger lepidolites, gives a maximum value of 22, and a most probable value of 11 for the ratio of radiogenic Ca^{40} to residual K^{40} in the $2{\cdot}1 \times 10^9$ year old minerals. Revised disintegration constants lead to a sufficiently smaller thermal output by K early in the earth's history to satisfy Birch's calculations on the possibility of an early solid terrestrial crust, and to remove arguments relating to the origin of species through gene mutations caused by intense K^{40} radiations early in the earth's history. A.

539.163.2 3896

Gamma-ray spectrometer measurements of fluorine and lithium under proton bombardment. Walker, R. L., and McDaniel, B. D. *Phys. Rev.*, **74**, 315–27 (*Aug.* 1, 1948).—The spectra of the γ-radiation emitted by Li and F were investigated with a spectrometer which measures the total energy of electron pairs produced in a thin radiator exposed to the γ-radiation. A long-suspected 14·8 MeV γ-ray line from the 440 keV resonance in Li was clearly resolved from the well-known sharp line at 17·6 MeV. The γ-radiation from F was found to consist of two lines at 6·13 ± 0·06 and 6·98 ± 0·07 MeV, rather than a

single line as previously believed. Possible variations in the positions and in the relative intensities of the two lines of each spectrum, with changes in the proton energy, were investigated by using protons of energies approximately 0·45, 0·7, and 1·15 MeV from the Cornell cyclotron. The γ-ray spectrometer used in these measurements is described, and a discussion given of the factors limiting its resolution. The resolution is such that the observed width at half-maximum of a sharp γ-ray line is approximately 5·5% of its energy. A.

539.163.2 = 4 3897

Spectra of the positive and negative radiations from Ra (D + E + F). VIEIRA, G. *C.R. Acad. Sci., Paris*, **226**, 1189–91 (*April* 12, 1948) *In French.*—In direct magnetic deviation experiments, lines ($H\rho$ = 31·3, 15·8, 10·5, 7·5 × 10^3 gauss cm) have been obtained which would correspond to positive and negative electrons emitted from the Ra (D + E + F) source with energy greater than the maximum energy of the RaE β-spectrum. As the lines appear symmetrical w.r. to the central spot it is suggested that the particles involved are produced in a process of pair production. The energy available for this process is not large enough on the assumption that the particles are electrons, but this difficulty disappears if the particles be identified with the microelectrons of Gião, of mass and charge 32 times < the electron [*C.R. Acad. Sci., Paris*, **224**, 454 (1947)]. R. W. P.

539.163.2 : 537.531 : 535.42 3898

Precision wave-length and energy measurement of gamma-rays from Au^{198} with a focusing quartz crystal spectrometer. DU MOND, J. W. M., LIND, D. A., AND WATSON, B. B. *Phys. Rev.*, **73**, 1392–4 (*June* 1, 1948).—A focusing curved quartz crystal γ-ray spectrometer [Abstr. 345 (1948)] of focal length 2 m was used in the study of the 0·41 MeV γ-ray from a 1 curie Au^{198} source. The detector was a special multicellular Geiger counter. Reflections from the (310) planes were studied (Bragg angle ~ 20′) and the results yielded a mean value of $\lambda = 30{\cdot}143 \pm 0{\cdot}004 \times 10^{-11}$ cm, corresponding to an energy of 0·4112 ± 0·0001 MeV. Only ~ 0·3% of the incident γ-ray energy was reflected. It is estimated that at least 100 mc are required for the success of the method, but that a precision better than 1 in 10 000 is obtainable in the half million volt region. R. W. P.

539.163.2 : 539.152.1 3899

The beta-spectrum of S^{35} and the mass of the neutrino. COOK, C. S., LANGER. L. M., AND PRICE, H. C., JR. Letter in *Phys. Rev.*, **73**, 1395 (*June* 1, 1948).—Measurements were made with a large, high-resolution, shaped-field magnetic spectrometer [Abstr. 2551 (1948)]. The Fermi plot for the momentum distribution of the emitted electrons was straight for all energies from $W = 1{\cdot}17\ mc^2$ to the extrapolated Fermi end-point at $W_0 = 1{\cdot}331\ mc^2$, which corresponds to a kinetic energy of 169·1 ± 0·5 keV. A careful study of the shape of the Fermi plot in the immediate neighbourhood of the end-point showed the mass of the neutrino to be < 1% that of the electron [see Abstr. 1946 (1947)]. R. W. P.

539.163.2 : 539.167.3 = 4 *see Abstr.* 3921

539.163.4 : 539.162 = 3 3900

The argon content of potassium-containing minerals and the question of the dual decay of K^{40}. HARTECK, P., AND SUESS, H. *Naturwiss.*, **34** (*No.* 7) 214–15 (1947) *In German.*—An investigation has been made by a method which depends on the measurement of the thermal conductivity of N containing traces of A. The results produce a value for the branching ratio for the decay of K^{40} by *K*-capture compared to the total decay. In contradistinction to Thompson and Rowlands [Abstr. 2385 (1943)], who obtained a value of 0·78, this work yield figure of 0·1. The significance of the result is discusse G. O.

539.164 : 537.13 : 771.535 = 3 *see Abstr.* 4085

539.164.2 : 548.0 39

The emission of alpha-particles from different faces o radioactive crystal. MATHER, K. B., AND KURIE, F. N. *Phys. Rev.*, **73**, 1474 (*June* 15, 1948).—A crystal $ThSO_4$ was examined with respect to the rate of emissi of α-particles from its three crystallographically differe faces, by use of the photographic emulsion techniqu The differences in tracks per unit area among the thr faces were, within statistical error, caused by the fini number of tracks counted (about 800). It is conclud that the results of Mühlestein must have been in err [see *Arch. Sci.*, **2**, 240 (1920)]. R. W.

539.164.75 : 539.16.08 *see Abstr.* 3881

539.164.93 : 778.3 39

Alpha-particle and deuteron tracks in Eastman NT photographic plates. BROCK, R. L., AND GARDNER, *Rev. Sci. Instrum.*, **19**, 299–303 (*May*, 1948).—Eastma NTA photographic plates have been bombarded wi α-particles and deuterons in the 184 in Berkeley cyclotro and photomicrographs of sections of tracks have bee made and are reproduced here. The trajectories do n lie in the emulsion for the entire range of the particle and only short sections of track are available for stud In the tracks of low energy α-particles, and low energ deuterons, there are enough developed grains so that th tracks are nearly continuous. As the energy increase the number of developed grains in the track decreases, th number for the deuterons decreasing more rapidly tha that for the α-particles. In the tracks of α-particles c 200 MeV and lower, and of deuterons of 20 MeV an lower, there are enough developed grains so that th tracks can be followed easily.

539.165 390

Identification of beta-rays with atomic electrons GOLDHABER, M., AND SCHARFF-GOLDHABER, G. *Phys Rev.*, **73**, 1472–3 (*June* 15, 1948).—Soft β-particles (ma energy 155 keV) from a C^{14} source were completel absorbed in a 24 mg/cm² Pb foil, and any soft photon and secondary electrons were removed by filtering wit further foils of Cu and Al. An open-ended Geige counter was used as detector. It was estimated tha < 3% of the β-rays stopped in the Pb could have pro duced *K* X-rays by capture into the *K* shell. Thi operation of the Pauli exclusion principle means that th β-rays at the end of their path must be identical wit atomic electrons in all respects [Abstr. 2188 (1948)]. R. W. P

539.165 : 537.533.72 *see Abstr.* 3789

539.165 : 539.18 *see Abstr.* 3949

539.165/.166 390

The beta- and gamma-spectra of gallium irradiated by slow neutrons. HAYNES, S. K. *Phys. Rev.*, **74**, 423–32 (*Aug* 15, 1948).—The β- and γ-ray spectra of Ga irradiated with slow neutrons were investigated with a thin magnetic lens spectrometer. Probable β-ray end points for Ga^{72} at 3·15 MeV (9·5%), 2·52 MeV (8%), 1·48 MeV (10·5%), 0·955 MeV (32%), and 0·64 MeV (40%) were found. A conversion line occurring in about 0·5% of the disintegrations was observed at 0·68 MeV. γ-rays of 2·51 MeV (26·5%), 2·21 MeV (33%), 1·87 MeV (7·8%), 1·59 MeV (4·5%), 1·05 MeV (4·5%), 0·84 MeV (100%) and 0·63 MeV (24%) were also found for Ga^{72}. A nearly complete decay scheme for Ga^{72} is suggested. The β-ray spectrum of Ga^{70} (20·5 min) was also observed with the

spectrometer. The Kurie plot is linear from the end point of 1·65 MeV to 0·4 MeV. No evidence of conversion lines in this energy interval was found. A.

539.165.2 : 539.163.1 = 4 *see Abstr.* 3888

539.165.2 : 778.3 3905

The detection of beta-radiation by photographic film. COBB, J., AND SOLOMON, A. K. *Rev. Sci. Instrum.*, **19**, 441–7 (*July*, 1948).—The effect of β-radiation from C^{14} was examined on 19 different films. The method employed uses a "radiator," a set of 8 radiating sources of different intensities, to replace the stable light sources and absorbing wedge common in spectral photometry. With this device, sensitivity and contrast of the 19 films were measured. Based upon these results and a microscopic estimation of grain size, recommendations are made for the most desirable film for use in radioautography and detection of radioactivity. A.

539.166 3906

Correlation between the states of polarization of the two quanta of annihilation radiation. BLEULER, E., AND BRADT, H. L. Letter in *Phys. Rev.*, **73**, 1398 (*June* 1, 1948).—A Cu^{64} source was used to provide a collimated beam of oppositely moving annihilation quanta. The azimuthal variation of intensity of the simultaneous Compton scattering in Al of the associated quanta was studied as a means of verifying the predicted perpendicular correlation of the respective planes of polarization [see Abstr. 621 (1947)]. Two bell-shaped Pb cathode counters were used as detectors for quanta scattered through 90°, and coincidences between the counter discharges were measured for azimuthal differences of 0, 90° ($C_\perp$), 180° ($C_\parallel$), 270° between the counter axes. An asymmetry ratio $C_\perp/C_\parallel = 1{\cdot}9_4 \pm 0{\cdot}3_7$ was obtained, agreeing with a predicted value of $\sim 1{\cdot}7$ [see Abstr. 3640 (1947)]. R. W. P.

539.166.08 : 548.0 : 549.211 3907

Remarks on diamond crystal counters. LONSDALE, K. Letter in *Phys. Rev.*, **73**, 1467 (*June* 15, 1948).—Ultraviolet opaque (type I) diamonds do not have a mosaic or laminated structure but approach to the perfect crystal [see Abstr. 2191 (1948)]. This is shown by the results of diffraction and absorption experiments with X-rays. Type II diamonds, however, appear laminated, and it seems possible that the secondary electrons counted when the crystals are exposed to γ-rays are those which move along the boundaries, and not through the crystal proper. R. W. P.

539.166.835 3908

Internal pair conversion. WANG, M. H. *Nature, Lond.*, **162**, 264 (*Aug.* 14, 1948).—Coefficients of internal pair conversion have been calculated for magnetic dipole γ-radiation [cf. Jaeger and Hulme, Abstr. 1096 (1935)] with $Z = 84$. The values given are $1{\cdot}5\times10^{-3}$ for $h\nu = 2{\cdot}62$ MeV; $5{\cdot}6\times10^{-3}$ for $h\nu = 8{\cdot}00$ MeV. Energy distribution curves for the emitted positrons are shown for these two cases. R. W. P.

539.166.835 : 537.12 3909

Angular distribution in internal pair creation. HORTON, G. K. *Proc. Phys. Soc., Lond.*, **60**, 457–60 (*May*); *Corrigenda*, **61**, 296 (*Sept*, 1948).—The mechanism of pair creation can be distinguished by the frequency distribution of the angles between the members of the emitted pair without knowing the total cross-section. Not only does the mean angle depend on whether an electric dipole as opposed to an electric quadrupole or magnetic dipole transition is involved, but the ratio of emission of the pair in the same directions to that of emission in opposite directions is much smaller for the first than for the second and third types. The difference is the greater if the particles have equal energy. G. J. K.

539.166.835 : 537.12 3910

Pair production by γ-rays in the field of an electron. VOTRUBA, V. Letter in *Phys. Rev.*, **73**, 1468 (*June* 15, 1948).—Values of the cross-section have been obtained for this 3rd-order process for small γ-ray energies; and for large γ-ray energies in the limit of either small recoil energy, or small positron energy, or all energies large. The results confirm the conclusions of Wheeler and Lamb [Abstr. 2630 (1939)] that processes where there is a large momentum transfer to the incident electron do not appreciably affect the cross-section. G. J. K.

539.167.3 3911

Disintegration of antimony-124. FEISTER, I., AND CURTISS, L. F. *J. Res. Nat. Bur. Stand., Wash.*, **40**, 315–19 (*April*, 1948).—The radiations from radio-Sb of 60-day half-period (Sb^{124}), were investigated in a magnetic lens electron spectrometer. The β-ray spectrum was found to have 2 components with maximum energies of $0{\cdot}57 \pm 0{\cdot}02$ and $2{\cdot}24 \pm 0{\cdot}05$ MeV. The γ-ray spectrum has 2 lines, one at $0{\cdot}60 \pm 0{\cdot}01$ and the other at $1{\cdot}69 \pm 0{\cdot}02$ MeV. It appears quite certain that the 0·60 MeV γ-ray originates from Sb^{124}, and therefore these measurements substantiate the disintegration scheme proposed by Meyerhof and Scharff-Goldhaber [Abstr. 3298 (1947)], with a small revision of energies. A.

539.167.3 3912

Search for elements 94 and 93 in nature. Presence of 94^{239} in pitchblende. SEABORG, G. T., AND PERLMAN, M. L. *J. Amer. Chem. Soc.*, **70**, 1571–3 (*April*, 1948).—Np and Pu have been separated and concentrated chemically from U and Th in a sample of Great Bear Lake pitchblende and by fission counts with slow and fast neutrons—the sample being precipitated with rare earth carrier—the upper limit of 1 part in 10^8 has been set for the amount of Np and Pu in the sample. The amount of 30 000 yr Pu^{239} is estimated as 1 part in 10^{14} from α-particle counts. W. R. A.

539.167.3 3913

Shipping of radio-isotopes. MORGAN, K. Z. *J. Appl. Phys.*, **19**, 593–8 (*July*, 1948).—General discussion of the problem; new and proposed regulations for shipment by road, rail and air.

539.167.3 3914

A method for measuring short period activities. SCHELBERG, A. D., SAMPSON, M. B., AND MITCHELL, A. C. G. *Rev. Sci. Instrum.*, **19**, 458–61 (*July*, 1948).—By photographing an oscilloscope it is possible to measure short periods ranging from 0·1 sec to 5 sec. The pulses from a Geiger counter are fed into the x-axis amplifier of an oscilloscope using no sweep. An oscillograph recorder is used to photograph the c.r.t. so that a record of all the pulses from the counter is obtained. The activated target is moved from the bombardment position to the counting position in $\sim 0{\cdot}2$ sec by means of a pneumatic tube. Exposure of Ca to a 23 MeV α-particle beam resulted in an activity with a $\frac{1}{2}$-life of $0{\cdot}58 \pm 0{\cdot}04$ sec. This activity may be assigned to Ti^{43} produced by the reaction $Ca^{40}(\alpha, n)Ti^{43}$. A.

539.167.3 3915

Production of new Tc activities from separated Mo isotopes. MOTTA, E. E., AND BOYD, G. E. Letter in *Phys. Rev.*, **73**, 1470–2 (*June* 15, 1948).—Tc was formed by bombardment of enriched Mo isotopes by 15–20 MeV deuterons, and was extracted by a volatility separation method. Decay periods of 80 sec, 4·5 min, 40 min and 2·8 hr were observed, and the nature and energy of the radiation found in each case. A. P. F.

539.167.3 3916

Characterization of Tc activities produced by deuteron bombardment of separated Mo isotopes. MOTTA, E. E., AND BOYD, G. E. Letter in *Phys. Rev.*, **74,** 220–2 (*July* 15, 1948).—See Abstr. 3915 (1948). Further activities, of 50 min, 20 hr and 2·8 days, are reported. Decay and absorption curves are shown, and tentative mass assignments for the Tc isotopes responsible are made. A. P. F.

539.167.3 3917

Nuclear isomeric transitions of short periods. TREACY, P. B. Letter in *Nature, Lond.*, **162,** 186–7 (*July* 31, 1948).—An attempt to detect short-period activities ($\geqslant 100$ μsec) induced in Cu, Mo, Ag, Cd, In and Pb by X-rays $\leqslant 1{\cdot}05$ MeV is described. The targets were bombarded with a pulsed beam of electrons from a linear accelerator, the current being ~ 15 mA for ~ 5 μsec in each pulse. No radiations attributable to isomeric transitions were observed. A. P. F.

539.167.3 3918

Neutron induced radioactivity in certain rare-earth elements. CORK, J. M., SHREFFLER, R. G., AND FOWLER, C. M. *Phys. Rev.*, **74,** 240–3 (*Aug.* 1, 1948).—By activating specimens of La, Nd, Sm, Eu, Gd, and Tb in the Oak Ridge pile for a particularly long exposure, several hitherto unobserved radioactivities were found. Determinations were made of the ½-lives and of the β- and γ-energies by absorption and spectrometric methods. La and Nd were the only elements showing no internal conversion lines. Tb appears as a contaminant in its neighbouring elements by virtue of its very large cross-section for neutron capture. Tb and Eu show complex β-spectra, and each has many conversion electron lines. A.

539.167.3 3919

The disintegration of scandium^{46}, gold^{198}, and tungsten$^{185, 187}$. PEACOCK, C. L., AND WILKINSON, R. G. *Phys. Rev.*, **74,** 297–303 (*Aug.* 1, 1948).—A survey of the nature and energies of the radiations of some radioactive isotopes of Sc, Au, and W was made with a small 180° spectrometer of fair resolution. Samples were produced by neutron and deuteron activation. The 85-day isotope of Sc is found to decay by the emission of two groups of β-rays of maximum energies 0·36 and 1·49 MeV. The low energy group constitutes 98% of the total number of electrons. The residual Ti^{46} nucleus returns to the ground state by the cascade emission of two γ-rays with energies 0·89 and 1·12 MeV. The γ-rays are converted with K conversion coefficients of 0·0008 and 0·0004, respectively. The decay scheme of Au^{198} was found to be simple. The emission of a β-ray of a single group, $E_{max} = 0{\cdot}97$ MeV, leads to an excited state of Hg^{198} which returns to the ground state by the emission of a 0·408 MeV γ-ray. The γ-ray is converted with $\alpha_k = 0{\cdot}25$. The radiations of 24 hr W^{187} are complex. Two groups of β-rays are present which have end points at 0·63 and 1·33 MeV. Five γ-rays are noted with energies of 0·14, 0·21, 0·48, 0·62, and 0·69 MeV. The decay of the 77-day isotope, W^{185}, seems simple. A single β-ray is found with an end point at 0·43 MeV. A.

539.167.3 3920

The delayed coincidence method in the study of radioactivity, with application to isomerism in ^{181}Ta. BUNYAN, D. E., LUNDBY, A., WARD, A. H., AND WALKER, D. *Proc. Phys. Soc., Lond.*, **61,** 300–6 (*Oct.*, 1948).—A short-lived nuclear state occurring during a series of radioactive transitions can be studied by the observation of delayed coincidences between the radiations preceding and following the state in question. The method is limited to transition periods lying between about 10^{-7} and 10^{-2} sec. Two distinct experimental procedures ar possible, one yielding the differential and the other th integrated decay curve of the short-lived state. Th method was applied to the decay of the previousl reported 22 μsec metastable state in Ta^{181}, which formed in the decay of the β-ray emitter Hf^{181}. It shown that the isomeric transition takes place in tw steps of 0·2 MeV and 0·5 MeV in instantaneous succes ion. The ½-life of the metastable level was redetermine as $(20{\cdot}1 \pm 0{\cdot}7) \times 10^{-6}$ sec. From a comparison of th observed and calculated internal conversion coefficient it seems probable that the 0·2 MeV and 0·5 Me transitions are of an electric octupole and electri quadrupole character respectively. This would mea that since the spin of the ground state of Ta^{181} is 7/ the 0·5 MeV state must also have a spin of 7/2 and th same parity as the ground state, while the metastabl state must have a spin of 1/2 and opposite parity. A

539.167.3 : 539.163.2 = 4 392

A contribution to the study of the disintegration schem of ^{198}Au, using the method of coincidences. RENARI G. A. *C.R. Acad. Sci., Paris,* **226,** 1269–71 (*April* 1 1948) *In French.*—γ-ray absorption measurement showed a complex radiation with a mean energy c 0·35 MeV. β-ray absorption measurements gave maximum energy of $0{\cdot}95 \pm 0{\cdot}03$ MeV, with a lo energy component of maximum energy 70 ± 7 ke (5 ± 1%), due either to a partial spectrum or a photo electron line. Coincidences (β–γ), (γ–γ), and (β–e^-) wer studied and the results of these measurements were i best agreement with the disintegration schemes of Norlin [Abstr. 248 (1944)] and of Wiedenbeck and Chu [Abstr 1052 (1948)]. R. W. H

539.167.3 : 541.123.33.036 : 621.384.6 392

Recoil-activated and thermal exchange reaction between sulfur-35 and carbon disulphide. EDWARDS R. R., NISBET, F. B., AND SOLOMON, A. K. *J. Amer. Chem. Soc.*, **70,** 1670 (*April*, 1948).—Preliminary notice i given of two exchange reactions between S^{35}* and CS yielding CSS*. In the first reaction a 10-vol.-% solution of CS_2 in CCl_4 was placed in the stray neutron field nea the Massachusetts Institute of Technology cyclotron fo one month and the total S^{35}* activity and that present a CS_2 were assayed by Carius analysis. About 50% of the S^{35}* formed in compounds not volatile at room tempera ture was contained in CS_2. In a second experimen 1 g C_2Cl_6 in 1 ml of CCl_4 was sealed in a quartz tub and bombarded in the Oak Ridge pile for 30 days. Afte assay 12% of S^{35}* was present as CSS*. The exchange o sulphide ion in aqueous solution with CS_2 as a separate phase proceeds, apparently, by sulphide exchange with thiocarbonate ion (CS_3''). W. R. A

539.167.3 : 542.942.3 392

Production of radioactive carbon monoxide and phosgene from barium carbonate. HUSTON, J. L., AND NORRIS T. H. *J. Amer. Chem. Soc.*, **70,** 1968–9 (*May*, 1948).—Radioactive BaC^*O_3, treated with 85% H_3PO_4, yielded C^*O_2 which was reduced by Zn at 385 ± 5° to C*C which was photochemically converted to C^*OCl_2. W. R. A

539.169 392

The effects of pile bombardment on uncured elastomers DAVIDSON, W. L., AND GEIB, I. G. *J. Appl. Phys.*, **19** 427–33 (*May*, 1948).—Relatively thick samples of natura rubber, butyl rubber, and polyisobutylene were subjected to uniformly high concentrations of radiation. The results are: (1) Uncured natural rubber undergoes a slight curing action when exposed to pile radiations; (2) poly-isobutylene samples are appreciably degraded by pile radiations; (3) the same effects as noted in (1) and (2) are

greatly enhanced by secondary α-particles, produced by an (n,α) reaction on B^{10}; but even a 2-hour bombardment of natural rubber yields a product greatly inferior to S vulcanizates; (4) pile bombardment does not introduce measurable unsaturation in polyisobutylene and decreases the unsaturation in natural rubber but slightly, (5) a typical butyl rubber stock is permanently degraded by pile irradiation showing upon cure reduced tensile strength compared to that of a control sample, (6) natural rubber shows a weak but measurable radioactivity days after bombardment, probably because of its mineral content. Polyisobutylene is not appreciably active. A.

539.169 : 541.14 3925

The relation of radiation chemistry to photochemistry. STEACIE, E. W. R. *J. Phys. Coll. Chem.*, **52**, 441–6 (*March*, 1948).

539.169 : 541.183.26 *see Abstr.* 4008

539.17 3926

The freezing-in of nuclear equilibrium. UBBELOHDE, A. R. *Proc. Phys. Soc., Lond.*, **61**, 96–7 (*July*, 1948).—Recent data [Abstr. 1965 (1947)] is used to extend previous work [Abstr. 980 (1947)] on the dependence of abundance ratios of stable isotopes on the freezing-in of thermodynamic equilibrium. L. S. G.

539.17 3927

Reaction constants for $Li^7(p,n)Be^7$. TASCHEK, R., AND HEMMENDINGER, A. *Phys. Rev.*, **74**, 373–85 (*Aug.* 15, 1948).—Absolute values for the reaction cross-section of $Li^7(p,n)Be^7$ are given for proton energies between 1·86 MeV and 2·5 MeV. Detailed angular distributions and their analyses are presented and the use of the reaction as a variable-energy neutron source is discussed. A.

539.17 3928

Resonances in $Li^7(p,n)Be^7$. BREIT, G., AND BLOCH, I. *Phys. Rev.*, **74**, 397–404 (*Aug.* 15, 1948).—A qualitative and schematic discussion of the theory of the angular distribution of neutrons emitted in the reaction $Li^7(p,n)Be^7$ is presented. Evidence concerning existence of quasi-stationary states is discussed with the conclusion that there are indications of two such states, one at ~2·2 MeV incident proton energy and another below the reaction threshold. Both levels are probably of odd parity. The existence of the level below threshold is based on less direct evidence than that of the level at ~2·2 MeV. It is assumed that Be^7 is left either in its ground state or another state of the same parity. A.

539.17 3929

Angular distribution of alphas from $Li^6(d,\alpha)\alpha$ and $Li^7(p,\alpha)\alpha$. HEYDENBURG, N. P., HUDSON, C. M., INGLIS, D. R., AND WHITEHEAD, W. D., JR. *Phys. Rev.*, **74**, 405–10 (*Aug.* 15, 1948).—The intensity of the reaction $Li^6(d,\alpha)\alpha$ was observed to vary with angle as $1 + A(E)\cos^2\theta + B(E)\cos^4\theta$, as expected from the Bose statistics of the product α's, with $A(E)$ rising gradually, beginning just below 1 MeV, to a broad maximum a little below unity at a bombarding energy E in the neighbourhood of 2 MeV. The coefficient $B(E)$ remains zero up to almost 1·5 MeV and rises to a positive value of about 0·35 at higher energies. The yield curve observed at right angles to the beam displays a sharp maximum at 0·75 MeV and there is evidence of approach to another peak at or just beyond the highest bombarding energy employed, 3·75 MeV. A peak in the yield curve of the reaction $Li^7(p,\alpha)\alpha$ was found at 3 MeV, which is about 3 MeV lower in the compound nucleus Be^8 than the lower peak observed in the reaction $Li^6(d,\alpha)\alpha$. There is great similarity in the trends of the angular distributions of the two reactions, but their coefficients $B(E)$ have opposite signs in the energy regions investigated, and both $A(E)$ and $B(E)$ rise from zero more gradually in $Li^6(d,\alpha)\alpha$ than in $Li^7(p,\alpha)\alpha$ as the bombarding energy increases from low values. A.

539.17 = 82 3930

Inverse Oppenheimer–Philipps process. GALANIN, A. *J. Exp. Theor. Phys.*, **18**, 559–61 (*June*, 1948) *In Russian.*—The reaction $X^m(He^3, He^4)X^{m-1}$ on a heavy nucleus is considered as the "inverse" of the Oppenheimer–Philipps process. It is shown that the probability of such a reaction for an energy of several MeV of the He^3 is exceedingly small. A.

539.17 : 539.155.2 : 535.338.4 *see Abstr.* 3684

539.172 = 4 3931

On the bi-partition and tri-partition of heavy elements. TSIEN, S.-T. *J. Phys. Radium* (*Sér.* 8) **9**, 6–19 (*Jan.*, 1948) *In French.*—Simple modifications of the Bohr–Wheeler theory of two-particle fission are suggested to remove difficulties of asymmetry and the energy thresholds for fission of elements of medium weight. The suggested thresholds are lower for $A = 160$–180 than for $A = 180$–220. A simple theory of fission into 3 fragments gives qualitatively the range and direction of the third fragment, a value of $A/Z \geqslant 2$ for it, and the time of emission. A short-range fragment would occur when it was initially almost collinear with the 2 heavier fragments, and a long-range fragment when the 3 formed a triangle. Long range can be correlated with a small excitation energy of the compound nucleus. G. J. K.

539.172.1 3932

Nuclear reactions of arsenic with 190 Mev deuterons. HOPKINS, H. H., JR., AND CUNNINGHAM, B. B. Letter in *Phys. Rev.*, **73**, 1406–7 (*June* 1, 1948).—Chemical separations were made from As after bombardment, and the decay curves for the various elements were resolved into their component ½-lives. Activities as far down as Cr^{51} ($\Delta A = -24$) were identified. A. P. F.

539.172.1 + 539.172.4 = 82 *see Abstr.* 3939

539.172.3 3933

On γ-induced β-disintegration: experimental. BURLING, R. L., AND KURIE, F. N. D. Letter in *Phys. Rev.*, **74**, 109–10 (*July* 1, 1948).—A strong Mn^{56} γ-source was placed in a vessel filled with distilled water, and the neutron density produced was measured with an Ag detector. Further measurements were made after addition of small amounts of D_2O and of a solution of Be. The neutron yields due to photo-disintegration of Be, D and H were found to bear the ratios $1 : 0{\cdot}2 : < 5 \times 10^{-5}$. An upper limit of 4×10^{-32} cm² is deduced for the cross-section of the process $p + \gamma \rightarrow n + e^+ +$ neutrino at ~2 MeV γ-ray energy. A. P. F.

539.172.3 3934

On γ-induced β-disintegration: theoretical. PRIMAKOFF, H. Letter in *Phys. Rev.*, **74**, 110 (*July* 1, 1948).—The cross-section for photo-disintegration of the proton was found to be $\sim 10^{-46}$ cm² at ~2 MeV, using the Fermi theory of β-decay. This is ≪ the upper limit set by experiment. A. P. F.

539.172.3 3935

Photodisintegration of the deuteron. WILSON, R., COLLIE, C. H., AND HALBAN, H. Letter in *Nature, Lond.*, **162**, 185–6 (*July* 31, 1948).—Photo-protons produced by the 2·62 MeV γ-rays from a calibrated RdTh source were counted, using electron collection, in an ionization chamber filled with D_2 at 6 atm. The total cross-section (magnetic + electric photo-effect) was found to be $(16{\cdot}2 \pm 1{\cdot}0) \times 10^{-28}$ cm². This favours use of a light meson (~200 m_e) in nuclear force theory, but the result

is not accurate enough to decide between different theories. A. P. F.

539.172.3 3936

Relative yields of some X-ray induced nuclear reactions. PERLMAN, M. L., AND FRIEDLANDER, G. *Phys. Rev.*, **74**, 442–8 (*Aug.* 15, 1948).—X-rays from the 100 MeV betatron and 80 MeV synchrotron were used to induce (γ,n), (γ,p), $(\gamma,2n)$ and $(\gamma,2p)$ reactions. Relative yields for a number of these reactions were determined by measurement of the activities of the products. Yields of (γ,n) reactions appear to be about an order of magnitude larger for $Z \geqslant 29$ than for lower Z; the transition seems to be abrupt. The five (γ,p) reactions studied have approximately equal yields, and these are about the same as (γ,n) yields below the transition. Values for the few $(\gamma,2p)$ yields measured are about one-twentieth those for the (γ,p) reactions. Yields for the $(\gamma,2n)$ reactions vary, but are much smaller than (γ,n) yields. The most probable number of particles emitted as the result of the interaction of a high energy quantum with a nucleus is one. A.

539.172.4 3937

The emission of light charged particles in the slow neutron fission of uranium. GREEN, L. L., AND LIVESEY, D. L. *Philos. Trans. A*, **241**, 323–43 (*Aug.* 31, 1948).—A description is given of the extension of the photographic plate technique to the recording of fission fragment tracks and the application of the method to the study of rare modes of fission in the case of slow neutron fission of U. The emission of a short-range group of light particles in the fission of U^{235} is confirmed. The angular distribution of these particles and the emission of long-range light particles with ranges up to 45 cm of air are described. The abundance of this mode of fission is 1 in 340 ± 40 fission events. The angular and range distributions of these long-range particles are given. A.

539.172.4 = 4 3938

Fluctuations of range in Al and Au for a given fission fragment of U. SUZOR, F. *C.R. Acad. Sci., Paris*, **226**, 1081–3 (*March* 31, 1948) *In French.*—Experiments already described [Abstr. 2243, 3305 (1947)] were repeated using Ni instead of Cu as backing for the U film. This reduced the straggling, but still showed disagreement with the Bohr theory. A. P. F.

539.172.4 + 539.172.1 = 82 3939

Theory of the energy transmission in collisions. III. LANDAU, L., AND LIFSHITS, E. *J. Exp. Theor. Phys.*, **18**, 750–8 (*Aug.*, 1948) *In Russian.*—A method of exact determination of the effective fission cross-section of the deuteron for neutrons and protons moving in a Coulomb field is given. The energy and angular distribution of the particles separating after collision is determined. A.

539.172.4 : 621.385.15 3940

Use of an electron multiplier tube as a new technique in disintegration experiments. DEL ROSARIO, L. *Phys. Rev.*, **74**, 304–14 (*Aug.* 1, 1948).—A tube with 12 electrodes was used as a detector in the bombardment of Be by protons of energy 239, 268 and 397 kV. The disintegration particles from the two possible reactions, $Be^9(p,\alpha)Li^6$ and $Be^9(p,d)Be^8$, were selected by an electrostatic analyser which measured directly their energies. The results for each bombarding voltage are given as an energy distribution curve which shows a complete resolution of the various peaks. All the particles, except the unstable Be^8, were detected, an interesting feature being the detection of the recoil nucleus Li^6 in its three states of ionization. The width of the peaks coincide with the values predicted by the theory of the electrostatic analyser for the slits used in these experiments. The ratios in which the three Li ions appear are given and the problem of the probability for capture or loss of electrons by the ions is briefly discussed, on the basis of the ratio γ of the electron orbital velocity to the velocity of the ion itself. The calculated values for γ are: for the process $Li^{+++} \rightleftarrows Li^{++}$ $\gamma = 1{\cdot}22$, and for $Li^{++} \rightleftarrows Li^{+}$, $\gamma = 1{\cdot}09$. These favour the doubly ionized state of Li. The actual counting rates observed indicate, in fact, that the Li^{++} is the most abundant of the three ions. A.

539.174 = 4 3941

The disintegration of $^{18}_{9}F$. HO, Z.-W. *C.R. Acad. Sci. Paris*, **226**, 1187–9 (*April* 12, 1948) *In French.*—A cloud chamber study was made of the positrons emitted by F^{18}. The spectrum was analysed into groups of max. energies 0·6 and 0·95 MeV. Recoil electrons from a γ-ray of ~1·4 MeV were also observed; 3 slow electron groups were found, corresponding to γ-rays of 24, 36 and 52 keV and suggesting a *K*-capture process. From the intensities it was inferred that *K*-capture was ~20 times more likely than positron emission. A. P. F.

539.174 : 537.534.74 3942

An excited state of Be^9 by inelastic scattering of protons. DAVIS, K. E., AND HAFNER, E. M. Letter in *Phys. Rev.*, **73**, 1473 (*June* 15, 1948).—A thin Be target was bombarded with protons of 4·5 and 7·1 MeV, and the scattered protons at 37° were magnetically analysed. One low-energy group, corresponding to 2·41 MeV excitation of Be^9 (virtual state), was observed in both cases. A. P. F.

539.174.4 3943

The initial ionization produced by fission fragments. WEST, D. *Canad. J. Res. A*, **26**, 115–27 (*May*, 1948).—The ionization was measured (over various lengths of track) in a pulse ionization chamber provided with a grid. The distribution of electron pulse sizes for the complete track showed the well-known two peaks. As the length of track was diminished, the peaks corresponding to the high and low energy groups of fragments approached each other and merged together at a track length of about 6 mm in N_2. In smaller distances measured from the beginning of the track the difference in ionization by the two groups of fragments was found to be small, and the two groups could not be resolved. From the progressive change in shape of the pulse spectrum it is tentatively concluded that the low energy group produces the greater initial ionization. The average energy spent in ionization by the fragments in the first 1·1, 2·3 and 5·3 mm of their tracks was measured in N_2 and found to be 7·6, 15·0 and 34·6 MeV respectively. In the course of this work an effect due to the formation of negative ions by electron attachment was observed in the chamber filled with A. Examination of this effect suggests that, at high collecting fields, formation of negative ions, perhaps in impurities such as O_2 and H_2O vapour, is more pronounced in A than in N_2. A.

539.175 : 539.152.1 : 530.145 = 4 *see Abstr.* 3605

539.18 3944

On the lifetime of negative mesons. KRAUSHAAR, W. L. Letter in *Phys. Rev.*, **73**, 1408 (*June* 1, 1948).—Measurements of meson decay delays in C are quoted to show that the proper mean life of the negative meson is, within the accuracy of experiment, the same as that of the positive meson. J. G. W.

539.18 3945

Example of the beta-decay of the light meson. FOWLER, E. C., COOL, R. L., AND STREET, J. C. Letter in *Phys. Rev.*, **74**, 101–2 (*July* 1, 1948).—A photograph is given which from range and ionization density relations is con-

cluded to be the decay of a (200 m_0) meson to an electron. Decay takes place in a 0·02 cm Al foil, and the decay electron traverses 7 further similar foils. From the scattering at these, the energy of the decay electron is deduced to be 15 ± 3 MeV. J. G. W.

539.18 : 530.145 = 4 *see Abstr.* 3606

539.18 : 537.591 3946

A determination of the ratio of the masses of π- and μ-mesons by the method of grain-counting. LATTES, C. M. G., OCCHIALINI, G. P. S., AND POWELL, C. F. *Proc. Phys. Soc., Lond.*, **61**, 173–83 (*Aug.*, 1948).—A critical determination of the π/μ mass ratio is described, the value 1·65 ± 0·11 being obtained. If the μ-meson is assumed to be the normal cosmic-ray meson of mass 200 m_0, the momentum balance indicates a mass 115 ± 30 m_0 for the neutral decay particle. Attention is drawn to the problems of the grain-counting technique—foreshortening of inclined tracks, variation of grain density with depth in emulsion due to different degrees of development, variations of Ag halide in the emulsion, resolution of close grains, and the background fog of reduced grains. The constancy of range of the μ-meson for π–μ decay, and the lack of any correlation between the residual variations of range and the direction of the μ-meson track establishes that the π-meson comes to rest in every observed example before decay. The lower limit of the lifetime of the meson is estimated to be 4×10^{-11} sec. The uncertainty relation between energy and lifetime indicates a lower limit of lifetime of the neutral product of decay of $2\cdot6\times10^{-21}$ sec. J. G. W.

539.18 : 537.591.1 3947

Attempt to detect neutral particles produced by exchange of charge with cosmic-ray mesons. RUSK, R. D., AND ROSENBAUM, A. Letter in *Phys. Rev.*, **74**, 110–11 (*July* 1, 1948).—An attempt was made to detect charge exchange of mesons traversing matter, making use of two stages of exchange so that exchange would be detected if charged mesons entering the apparatus and leaving it could be shown to have passed an intermediate section in a non-ionizing condition. Mesons were detected in a fourfold telescope by their ability to pass through 7 cm Pb between the third and fourth counters. The second counter was connected in anticoincidence, and Fe and paraffin absorbers were interchanged above and below this counter. It is not possible to exclude that the effects observed might be due to the different scattering properties of these layers. J. G. W.

539.18 : 537.591.1 = 3 3948

On the existence of two values of the meson mass. HOGREBE, K. *Z. Naturforsch.*, **3a**, 61 (*Jan.*, 1948) *In German.*—Determinations of meson mass reported by Fretter [Abstr. 902 (1947)] and Hughes [Abstr. 1959 (1947)] are concluded, when appropriately weighted, to fall into groups corresponding to 2 mass values, 171 m_0 and 237 m_0. The relationship of mesons of these masses to the π–μ meson succession is considered. J. G. W.

539.18 : 537.591.8 *see Abstr.* 3827

539.18 : 539.165 3949

Cloud-chamber study of electrons from meson decay. ZAR, J. L., HERSHKOWITZ, J., AND BEREZIN, E. Letter in *Phys. Rev.*, **74**, 111–12 (*July* 1, 1948).—Electrons from meson decay were passed into a cloud chamber crossed by Al plates, and the momenta of the decay electrons estimated from the range through the plates and the scattering at them. Three electron tracks are estimated to have energies 13, 18, 50 MeV respectively. J. G. W.

539.181.71 : 548.7 = 3 *see Abstr.* 4024

539.185 3950

Slow neutron spectrometer studies of oxygen, nitrogen and argon. MELKONIAN, E., RAINWATER, L. J., HAVENS, W. W., JR., AND DUNNING, J. R. Letter in *Phys. Rev.*, **73**, 1399–1400 (*June* 1, 1948).—The results of transmission experiments for gaseous samples are presented in graphical form. A. P. F.

539.185 3951

High energy neutron-proton scattering. CHEW, G. F., AND GOLDBERGER, M. L. Letter in *Phys. Rev.*, **73**, 1409 (*June* 1, 1948).—The results are given of calculations on *n–p* scattering at 80 MeV, using the interaction potential from symmetrical meson theory with the tensor force omitted. The quantities obtained were the total cross-section and the ratio of scattered intensities at 180° and 90°. The latter is much closer to the experimental value than the corresponding figure obtained with a square-well potential. A. P. F.

539.185 3952

Transmission of monoenergetic slow neutrons through solid solutions and mechanical mixtures of TiC and WC. SIDHU, S. S. *J. Appl. Phys.*, **19**, 639–42 (*July*, 1948).—TiC and WC form continuous substitutional solid solutions at least up to 25% TiC + 75% WC by weight when heated to 4 000°F, TiC being the solvent and WC the solute. Total neutron scattering cross-sections of a series of finely powdered solid solutions and corresponding mechanical mixtures of the two carbides were determined as a function of the mole % of WC from the measured transmission of monoenergetic neutrons with energies 0·08138, 0·03479, 0·02056 and 0·01526 ev or wavelengths λ = 1·004, 1·536, 1·998 and 2·319 Å, respectively. The cross-sections of both the solutions and the mixtures increase with increasing mole % of WC. For mixtures they are the same as the additive cross-sections, each constituent scattering independently of the other. They are analogous to X-ray scattering for the mixtures in which each constituent gives its own diffraction pattern and the patterns of the two constituents are superimposed. The neutron cross-sections of solid solutions are lower than those of the mixtures at low % of WC but increase rapidly with the concentration of the solute molecules. They appear to be sensitive both to the structure of the solvent and the concentration of the substituting atoms. A.

539.185 3953

Inelastic scattering of neutrons. CASSELS, J. M., AND LATHAM, R. Letter in *Phys. Rev.*, **74**, 103–4 (*July* 1, 1948).—The total cross-section of Fe was measured at 2 temps. for velocity-selected neutrons over the range 5–8 Å wavelength. Subtraction of the known capture and disorder-scattering cross-sections gave the inelastic cross-section, which appeared to be > that calculated in terms of a Debye spectrum of oscillator frequencies in the lattice. A. P. F.

539.185 3954

The polarization of neutrons by magnetized iron. CASSELS, J. M. Letter in *Phys. Rev.*, **74**, 111 (*July* 1, 1948).—The mean scattering length for Fe nuclei is deduced from cross-section measurements to be $9\cdot01\times10^{-13}$ cm. Use of this value in the formula for the single transmission effect in magnetized Fe reduces the existing discrepancy between theory and experiment. A. P. F.

539.185 3955

Properties of a hypothetical di-neutron. FEATHER, N. Letter in *Nature, Lond.*, **162**, 213 (*Aug.* 7, 1948).—An upper limit to the binding energy of the di-neutron is obtained from the known heats of reaction for the

processes $Be^9(\gamma,n)$, $Be^9(n,\alpha)$ and $Be^8 \rightarrow 2\alpha$. Its β-decay energy is deduced to lie in the range 2·2–2·9 MeV. Assuming the β-decay to be "super-allowed," the corresponding lifetime is 1–5 sec. Characteristic reactions involving the di-neutron are suggested. A. P. F.

539.185 3956

The slow neutron cross section of H. Jones, W. B., Jr. *Phys. Rev.*, **74**, 364–9 (*Aug.* 15, 1948).—The total cross-section of H_2O was measured with a slow neutron velocity spectrometer in the energy interval 0·003 to 100 eV. A treatment of the data for energies above 0·8 eV gave a value of $20{\cdot}0 \times 10^{-24}$ cm² for the free *n–p* cross-section. Measurements of the total cross-section of cyclohexane in the energy interval 0·8 to 100 eV were also made, and from these data a value of $20{\cdot}1 \times 10^{-24}$ cm² was obtained for the free *n–p* cross-section. Measurements of the O_2 and C cross-sections were made in order that the data on H_2O and cyclohexane could be corrected to obtain the bound proton cross-sections. The values obtained for these cross-sections for the high energy neutrons are: for O_2, $3{\cdot}7 \times 10^{-24}$ cm², and for C, $4{\cdot}7 \times 10^{-24}$ cm². The data on H_2O for energies below 0·8 eV yield evidence for the existence of a cross-section for inelastic scattering of neutrons by H_2O. A.

539.185 : 530.145 3957

A convergent expression for the magnetic moment of the neutron. Rivier, D., and Stueckelberg, E. C. G. Letter in *Phys. Rev.*, **74**, 218 (*July* 15, 1948).—A convergent expression is obtained by an invariant perturbation method based on the *S*-matrix theory, which is equivalent to an invariant subtraction process. The magnetic moment is finite, although no definite value is obtained. G. J. K.

539.185 : 537.133 : 530.145 *see Abstr.* 3599–601

539.185 : 537.133 : 530.145 = 4 *see Abstr.* 3602

539.185 : 537.591.15 *see Abstr.* 3821

539.185 : 537.591.5 *see Abstr.* 3826

539.185 : 537.591.8 *see Abstr.* 3828

539.185 : 548.0 3958

The resonance scattering of slow neutrons in crystals. Sternheimer, R. *Phys. Rev.*, **74**, 335–40 (*Aug.* 1, 1948).—The theory of the diffraction of neutrons in single crystals is extended to the case in which the neutron energy lies in the region of a nuclear resonance. Equations describing the Laue–Bragg scattering are derived. A.

539.185.74 = 4 3959

Slowing down of fast neutrons in graphite. Houriet, A., and Kind, A. *Helv. Phys. Acta*, **21** (*No.* 2) 143–50 (1948) *In French.*—A method is developed for calculating the space-energy distribution of neutrons at all stages of slowing down, given that the source is a point and that the spread of initial neutron energies is approximated by a Gaussian. Scattering is assumed elastic and isotropic; absorption is neglected. A. P. F.

STRUCTURE OF SOLIDS 539.2

539.211 : 621.313.2.047.43 3960

Carbon film formation and commutator brush-wear as revealed by the electron microscope. Fullam, E. F., and Savage, R. H. *J. Appl. Phys.*, **19**, 654–61 (*July*, 1948).—The faces of carbon or graphite brushes, polished by rubbing against a rotating Cu disc and subsequently examined with the electron microscope by means of surface replicas, are found to consist of many tilted "fingers," which are the projecting portions of the large and irregular graphite plates composing the brush. These graphite projections show a directional overlap, which is determined by the direction of motion of the disc, a when viewed stereoscopically they are found to inclined at various angles up to nearly 90° with referer to the plane of the rotating base. The brush track on rotating Cu base is found to contain small islands carbon deposited from the brush. These islands cons of large numbers of graphite wear-fragments, which individually of very small size in comparison with projections of the brush face. These fragments derived from the projections by a tearing apart of th edges and are packed tightly and with random arran ment into the tool marks of the Cu smoothing over irregularities of the latter. The wear-dust of unlubricat graphite is found to consist of particles which are ve small in average size compared with those from wh brushes are manufactured. The size of these we fragments extends below the resolving power of electron microscope, and this is consistent with rec data on similar particles of a size determined in pendently by adsorption measurements.

539.213 : 666 39

The viscosity and nature of glass. Stanworth, J. E. *Soc. Glass Tech.*, **32**, 20–31 (T) (*Feb.*, 1948).—The viscosi temperature properties of glass are discussed on the ba of the theories of Frenkel and of Eyring, and it is co cluded, in contrast to the views of Seddon, that t moving particles, at least in the temperature range abo the annealing temperature, are not large compared wi single molecule size. The rapidly changing viscosity c be explained on the basis of changing entropy and ener of activation, the moving particles remaining constant size with change of temperature. Some suggestions a made concerning the effect of temperature and of co position changes on the energy of activation.

539.215 : 537.312.6 : 536.413 = 4 *see Abstr.* 3736

539.215 : 548.5 *see Abstr.* 4018

539.216.1 : 539.26 39

Quantitative X-ray investigations on the crystallinity cellulose fibers. A background analysis. Hermans, P. H and Weidinger, A. *J. Appl. Phys.*, **19**, 491–506 (*Ma* 1948).—A study of the intensity of scattered radiation a series of native and regenerated cellulosic objec The technique used involves the use of Cu radiati monochromatized by reflection, specimens with ra domized orientation of equal size and density, rotati of the plane film, and measurement of primary bea intensity by means of a device introduced by Gopp [Abstr. 1082 (1948)]. The procedure of evaluati consists of measuring integrated intensities of th crystalline peaks and that of the diffuse backgroun which is represented by a curve exhibiting a flat maximu whose height was assumed to be a correct relative measu of the disordered portion. The total intensity of th coherently diffracted radiation of the crystalline peak was taken as a relative measure of the crystalline portio Fibres investigated include cotton, cotton linters, rami flax fibres, woodpulp, a series of rayons, includi slightly and highly orientated viscose rayons, Cellophan Lilienfeld rayon and cuprammonium rayon. T relative proportions of the fractions of disordered su stance, for all objects investigated, are in satisfacto quantitative agreement with those deduced from th sorptive capacity for water vapour. The absolute pe centage of the crystalline portion calculated from th experimental data is 70 ± 2% for the native fibres a 39 ± 3% for the rayons.

539.216.1 : 539.32 *see Abstr.* 3972

539.216.1 : 539.4.01 *see Abstr.* 3982

539.217 : 531.728 : 539.27 3963

Permeability studies. III. Surface area measurements of carbon blacks. ARNELL, J. C., AND HENNEBERRY, G. O. *Canad. J. Res. A*, **26**, 29–38 (*March*, 1948).—The modified Kozeny equation is satisfactory for the measurement of the specific surfaces of carbon blacks having average particle diameters ranging from 0·01 to 0·1 μ to within $\pm 10\%$. Comparative data were obtained from electron microscope counting and from low temperature nitrogen adsorption isotherms. The three methods examined gave results that were in satisfactory agreement, except when the carbon black was porous, and then the adsorption value was extremely large. A.

539.217.1 : 541.183.26 3964

The determination of pore size distribution from gas adsorption data. SHULL, C. G. *J. Amer. Chem. Soc.*, **70**, 1405–10 (*April*, 1948).—The interpretation of gas adsorption data in terms of capillary condensation is discussed and it is suggested that in evaluating multilayer thicknesses of adsorbed layers at the higher relative pressures (0·35 to 0·99) empirical use of adsorption data for materials of large crystal size is preferable to using the Brunauer–Emmett–Teller theory. A method of applying the capillary condensation theory to experimental data so as to obtain pore size distribution has been worked out and applied to systems of N on silica gel. W. R. A.

539.219.2 : 539.389 = 4 3965

Influence of homogeneous deformation on the internal friction of a solid solution. BOULANGER, C. *C.R. Acad. Sci., Paris*, **226**, 1170–1 (*April* 12, 1948) *In French.*—Experiments were done on 80/20 NiCr alloy, the internal damping and its rate of decrease immediately after deformation being measured as a function of amount of permanent elongation. The residual internal damping after ageing was also measured. The results are interpreted in terms of the dislocation theory. L. G. C.

539.22 : 539.4.016.2 : 539.32 = 4 *see Abstr.* 3973

539.23 : 539.26 = 4 3966

The study of thin surface layers by means of X-rays: the use of reflection methods. LEGRAND, C. *J. Phys. Radium* (*Sér.* 8) **9**, 361–8 (*Dec.*, 1947) *In French.*—The use of a focusing method with monochromatic radiation is described for the study of thin surface layers. The method is suitable for use with thin layers upon amorphous or crystalline backgrounds, and has been used for the study of surface layers on steel and aluminium. A. E. DE B.

539.233 : 541.183 = 4 *see Abstr.* 4006

539.26 : 539.216.1 *see Abstr.* 3962

539.26 : 539.23 *see Abstr.* 3966

539.27 : 531.728 : 539.217 *see Abstr.* 3963

ELASTICITY . STRENGTH . RHEOLOGY 539.3/.8

539.3 : 53.081.5 3967

Application of dynamic similarity to metal structures with elastic and plastic flow. THRING, M. W. *Nature, Lond.*, **162**, 193–4 (*July* 31, 1948).—Dynamic similarity structures for metals depend upon dimensionless criteria in much the same way as fluid flow systems. When momentum and elasticity are the main factors, the velocities must be constant (that is, the time scale must be shortened proportionally in reducing from original to model). When elasticity and plasticity are the main factors, inertia being neglected, the time scale must be the same in model and original. The criterion in this case is deduced for a Kelvin solid only, but the assumptions on which similarity is based for problems where plasticity is important are discussed, together with the metal phenomena open to such treatment. A. J. K.

539.3 : 548.0 = 82 *see Abstr.* 4017

539.32 : 536.75 3968

The thermodynamics of a strained elastomer. I. General analysis. MOONEY, M. *J. Appl. Phys.*, **19**, 434–44 (*May*, 1948).—The basic partial differential equations of thermodynamics are integrated, yielding expressions for the energy and entropy of deformation in terms of observable quantities. Volume effects caused by changes in mean pressure and crystallinity are considered, and the effects associated with change in shape are sharply separated from those associated with change in volume. It is shown that the superelastic functions of deformation previously published [Abstr. 2892 (1940)] have a very general validity. A.

539.32 : 536.75 3969

The thermodynamics of a strained elastomer. II. Compressibility. COPELAND, L. E. *J. Appl. Phys.*, **19**, 445–9 (*May*, 1948).—Adiabatic compressibility coefficients were measured on a series of cured polymers of commercial types under pressures up to 5 000 lb/in^2. In most cases, the second-order as well as the first-order coefficient could be determined from the data. The linear isothermal compressibility was calculated from the measured linear adiabatic coefficient. Preliminary measurements of the thermal expansion of a stretched Hevea gum stock show that there is a slight decrease in expansion at the 200% elongation, presumably due to partial crystallization. A.

539.32 : 536.75 3970

The thermodynamics of a strained elastomer. III. The thermal coefficient of modulus and the statistical theory of elasticity. COPELAND, L. E., AND MOONEY, M. *J. Appl. Phys.*, **19**, 450–5 (*May*, 1948).—Published thermoelasticity data are critically analysed by means of thermodynamic equations developed in the first paper [Abstr. 3968 (1948)]. Equations known to be of the proper form are fitted by least squares to the experimental data, which were first corrected to allow for the changes in shape when tested under variable temperature and constant length. If the measurements are accepted as truly reversible, the data show that several different elastomers depart considerably in some respects from the predictions of the statistical theory of elasticity. Some thermoelasticity measurements in torsion are reported which seem to give the most reliable evidence that stress is proportional to absolute temperature. A.

539.32 : 537.311 3971

The Young's modulus and strain coefficient of resistivity of some bismuth rich alloys. KUCZYNSKI, G. C., AND NORTON, J. T. *J. Appl. Phys.*, **19**, 683–6 (*July*, 1948).—The modulus and strain coefficient were determined for some Bi–Pb, Bi–Sn, Bi–Se and Bi–Ni alloys. The modulus decreases rapidly in the regions of solid solution contrary to the predictions of Guillet. The strain coefficient increases rapidly within the limits of solid solubility while the stress coefficient remains constant. A.

539.32 : 539.216.1 3972

Method for the absolute measurement of dynamic properties of linear structures at sonic frequencies. LYONS, W. J., AND PRETTYMAN, I. B. *J. Appl. Phys.*, **19**, 473–80 (*May*, 1948).—A full account, including the theoretical basis, is given of a method whereby the dynamic stretch modulus, coefficient of internal friction, and hysteretic energy loss of textile yarns and cords, composed of either continuous filaments or staple fibres, can be accurately determined at longitudinal vibration

frequencies above 100 cycles/sec. The method, which employs electromagnetic excitation, is applicable also to glass cords, and metallic wires and cables. Results have been obtained at frequencies extending to above 300 cycles/sec. A concise description is given of the improved stretch vibrometer. Energy absorption by this instrument is negligible, permitting the calculation of an accurate internal friction coefficient, and absolute hysteretic loss. Measurements on eight natural and synthetic textile fibres reveal that the dynamic moduli range from $6{\cdot}4\times10^{10}$ dynes/cm² to 32×10^{10} dynes/cm². The internal friction coefficients vary hyperbolically with frequency. A.

539.32 : 539.22 : 539.4.016.2 = 4 3973

Elastic anisotropy of a cold-rolled invar foil. BOUCHET, P.-J. *C.R. Acad. Sci., Paris*, **226**, 1168–9 (*April* 12, 1948) *In French.*—Describes the variation of Young's modulus with direction before and after annealing. L. G. C.

539.32 : 539.382.08 = 4 3974

Measurement of Young's modulus for threads and films by a dynamic method. PINOIR, R., AND DUBOIS, A. *J. Phys. Radium* (*Sér.* 8) **9**, 20–4 (*Jan.*, 1948) *In French.*—A method is outlined for measuring the dynamic modulus of elasticity of threads and films. It consists in determining the velocity of wave propagation in the specimen; the wave being produced by a hammer striking the specimen support, while its time of departure and arrival, at a given test point, are recorded on a c.r.o. By synchronizing the frequency of the hammer blows with the sweep frequency of the spot, a steady picture is obtained. The method has been applied to several plastics, such as nitrocellulose, cellulose acetate, vinyl resins, nylon, etc., with an accuracy of 1½% in the determination of *E*. G. O. B.

539.37 3975

Perforated cover plates for steel columns: summary of compressive properties. STANG, A. H., AND GREENSPAN, M. *J. Res. Nat. Bur. Stand., Wash.*, **40**, 347–59 (*May*, 1948).—88 steel perforated cover plate columns were tested in the elastic range. The experimental axial rigidity under compressive load of the uniformly perforated lengths were compared with theoretical values. Agreement was very good. The distribution of stress on the edge of the perforation of these columns was also measured. The maximum values of stress concentration found experimentally agree also with theoretical values obtained for a single hole in a large plate. The values of the average stress on the net area for the compressive tests to destruction of 28 perforated plate columns were in nearly all cases greater than the maximum stress at failure for columns of the same size having solid plates. A.

539.37.08 3976

Calibration of X-ray measurement of strain. BENNETT, J. A., AND VACHER, H. C. *J. Res. Nat. Bur. Stand., Wash.*, **40**, 285–93 (*April*, 1948).—In order to increase the precision of strain determination by X-ray methods, 12 measurements of ring radius were made on each of two patterns for the customary incidence angles of 90° and 45°. For a specimen to which uniaxial stress was applied, a method was developed for handling the data to give one value representative of these 24 readings. When these values (obtained on a flat steel specimen loaded in bending) were compared with mechanical strain measurements, it was found that the X-ray measurements were proportional to the maximum principal strain up to the beginning of plastic deformation, and the precision was such that a change corresponding to 1 000 lb/in² should be detectable. A.

539.371 3

Large elastic deformations of isotropic materi IV. Further developments of the general theory. RIVL R. S. *Philos. Trans. A*, **241**, 379–97 (1948).—T equations of motion, boundary conditions and stre strain relations for a highly elastic material can expressed in terms of the stored-energy function, wh may be defined for a particular material in terms of invariants of strain. The form in which the equatio of motion, etc., are deduced [Abstr. 1094, 1095 (194 does not permit the evaluation of the forces necessary produce a specified deformation unless the act expression for the stored-energy function in terms of scalar invariants of the strain is introduced. T equations are now transformed into forms more suita for carrying out such an explicit evaluation. As exampl the surface forces necessary to produce simple shear a cuboid of either compressible or incompressi material and those required to produce simple torsion a right-circular cylinder of incompressible mater are derived.

539.373 : 548.0 39

Glide bands in silver chloride. NYE, J. F. Letter *Nature, Lond.*, **162**, 299–300 (*Aug.* 21, 1948).—Plas deformation of polycrystalline AgCl produces slip ban the height of the surface step being ~4 000 Å. T relation between this phenomenon of glide and t appearance of birefringent bands is examined (f instance, sharp birefringent laminations are visit between crossed nicols when a set of glide planes viewed edgewise). Although the glide plane containe in all but one case, the [110] direction, it was never exact coincidence with a crystallographic plane of lo indices (the average angle between them was 4·2°), n was the nearest plane always the same one. It is su gested that "pencil glide" takes place at room te perature, similar to that which occurs in Fe crystals. A. J.

539.374 : 539.388.24 *see Abstr.* 3980

539.382 39

The relationship between stress and strain for hom geneous deformation. VOCE, E. *J. Inst. Met.*, **74**, 536–((*July*, 1948).—A simple relationship with a rational bas has been found to connect stress with strain for a seri of homogeneous compression curves published by Coo and Larke. At large deformations each of the curv becomes asymptotic to a definite stress, and the differenc between this final stress and the threshold stress at whic plastic deformation begins to become appreciable ma therefore be regarded as the total stress capacity of th material. Similarly, the difference between any particula applied stress and that which is finally attained is the stres capacity remaining available after the application of th stress in question. Defining the plastic modulus, com parable with the elastic modulus, as the rate of change c stress with respect to true (logarithmic) strain, it is show that the plastic modulus at any instant $\propto$ the availabl stress capacity. The same relationship appears to hol for tension as well as for compression as long as th deformation remains homogeneous. E.g., it seems to b true up to the incidence of necking in the tensile test, an even beyond it in special circumstances. While thi relationship cannot be regarded as established, it i tentatively put forward and discussed with illustrativ examples. A

539.382.08 : 539.32 = 4 *see Abstr.* 3974

539.388.24 : 539.374 398

The extrusion of plastic sheet through frictionless rollers CARRIER, G. F. *Quart. Appl. Math.*, **6**, 186–92 (*July*

1948).—From the basic equation of the Saint Venant-Mises theory of slow plane plastic flow, a one-dimensional theory of the flow field, including the stress analysis, is developed. L. S. G.

539.389 : 539.219.2 = 4 *see Abstr.* 3965

539.389.3 : 666 3981

The mechanism of the reversible thermal after-effects in glass at ordinary temperatures. JONES, G. O. *Proc. Phys. Soc., Lond.*, **61**, 320–6 (*Oct.*, 1948).—An explanation is suggested for the after-effects which are responsible for the zero-depression in Hg-in-glass thermometers. A rough relation is established between these effects and the delayed elastic effects shown under ordinary mechanical stress. It is assumed that the thermal after-effects are delayed elastic strains resulting from stresses between regions of slightly differing composition, the origin of the stresses being the differing contractions of these regions during cooling from the annealing temperature. The model offers explanations for some detailed features of the behaviour, requiring inhomogeneities corresponding to differences of only a few % in the proportions of the main constituents to account for the observed effects. A.

539.4.01 : 539.216.1 3982

A theory of commercial yarn testing. GEYER, C. J., JR., REICHARDT, C. H., AND HALSEY, G. *J. Appl. Phys.*, **19**, 464–72 (*May*, 1948).—A method has been devised for the application of the theory of the 3-element shear model of Eyring and co-workers to textiles which does not necessitate the location of the "basic spring line" and thus is readily applicable to both yarn and fibre tests and to the commercial inclined-plane and pendulum-type testers. It is also applicable as a first approximation to those textiles which do not possess a "basic spring line" as such. The method employs the conventional spring constants or elastic moduli, but determination of the viscous constant involves the magnitude of the relaxation in constant rate of elongation experiments (or the magnitude of the creep in constant rate of loading experiments) from the upper envelope per interval of time. The simplicity of technique which enables this method to be used as a routine laboratory test for the determination of the visco-elastic properties of textiles affords it an advantage over previous methods, which were often unsatisfactory from both a theoretical and an experimental viewpoint. A.

539.4.011.25 3983

The effect of low temperatures on the breaking strength of sheet glass. HOLLAND, A. J. *J. Soc. Glass Tech.*, **32**, 5–19 (T) (*Feb.*, 1948).—Increases of ~20% on lowering the temperature from 17·5° to −40° are reported. Steady loading and impact tests were made on several hundred specimens. A.

539.4.016 : 535.55 : 666.1.037.5 *see Abstr.* 4083

539.4.016.2 : 539.22 : 539.32 = 4 *see Abstr.* 3973

539.411/.412 : 548.7 = 82 *see Abstr.* 4025

539.434 3984

Creep, recovery, and permanent set for GR–S and Hevea. GEHMAN, S. D. *J. Appl. Phys.*, **19**, 456–63 (*May*, 1948).—A study was made over a 1 000 hr period and a range of elongations at 35°C. Creep for GR–S is greater than for Hevea. The stress for GR–S is considered to be supported to a greater extent by a relatively unstable secondary bond structure. This is consistent with the large creep values for GR–S at low elongations and the large ratio of primary or recoverable creep to permanent set. Hevea shows low creep at both high and low elongations and maximum creep at intermediate elongations for which the structure is heterogeneous, consisting of amorphous and crystalline phases. A procedure was worked out for determining the contribution of permanent set to the observed creep. At the start of the creep test the flow appears to be due largely to the reversible yielding of relatively weak bonds which can reform under the action of the elastic network when the stress is removed. For longer periods of time, or for higher elongations, the flow involves more deep-seated changes in structure. Larger units of structure are displaced or stronger bonds broken with resultant permanent molecular displacements upon removal of the stress. For Hevea at high elongations all of the flow was accounted for by permanent set. A.

PHYSICAL CHEMISTRY 541

THERMO-CHEMISTRY 541.11

541.115 : 536.666 : 539.133 *see Abstr.* 3854–6

PHASE EQUILIBRIUM 541.121/.123

541.123.33.036 : 621.384.6 : 539.167.3 *see Abstr.* 3922

REACTION KINETICS 541.124/.128

541.124 : 536.7 = 4 *see Abstr.* 3752

541.124 : 542.952 : 541.182.4 *see Abstr.* 4002

541.126 3985

The detonation of solid explosives: the equilibrium conditions in the detonation wave-front and the adiabatic expansion of the products of detonation. JONES, H., AND MILLER, A. R. *Proc. Roy. Soc. A*, **194** (*No.* 1039) 480–507 (1948).—The velocity of detonation and the pressure-volume-temperature relation in the detonation wave-front are determined. The adiabatic pressure-volume relation for the expansion of the products of detonation, and the chemical composition during, and up to the end of, the adiabatic expansion are calculated. The calculations are compared with the available experimental data and are in reasonable agreement with it. A.

541.126 3986

The detonation velocity of axially cavitated cylinders of cast DINA. KIRSCH, M., PAPINEAU-COUTURE, G., AND WINKLER, C. A. *Canad. J. Res. B*, **26**, 435–40 (*May*, 1948).—A method is described for estimating velocities of detonation from the photographic record obtained on a rapidly moving film. The increase in detonation velocity in cavitated charges is accompanied by the appearance of a luminous effect which moves down the cavity approximately 1·6× faster than the detonation wave. Both the luminous effect and the increase in detonation velocity disappear when the cavity is filled with water. A.

541.126 3987

The mechanism of spark ignition. FROST, W. E., AND LINNETT, J. W. *Trans. Faraday Soc.*, **44**, 416–27 (*June*, 1948).—**II. Carbon monoxide-oxygen mixtures** (416–21).—[Pt I, Abstr. 3094 (1945)]. The spark ignition of CO–O_2 mixtures has been studied. It is found that the minimum ignition pressure falls very rapidly with increasing water content and that the addition of N_2 also lowers the limiting ignition pressure. A set of reactions has been suggested which accounts for the main features of the observations. It is suggested that the lowering of the minimum ignition pressure by N_2 occurs because the

inert gas impedes the diffusion of chain radicals from the region of the spark. That is, it is suggested that the inert gas effect here is the same as it was for H_2–O_2 mixtures and that the condition for ignition is, as for the H_2–O_2 ignition, the uncontrolled increase of chain-propagating radicals in the region of the spark. **III. Effect of adding organic vapours to hydrogen–oxygen mixtures** (421–7).—The effect of organic vapours on the limiting spark ignition pressure of electrolytic gas has been studied. While small amounts usually lower the ignition pressure, larger amounts exert a strong anti-ignition effect. It is suggested that this results because the organic molecules react readily with the radicals responsible for chain branching. A quantitative treatment in terms of probable elementary processes has been suggested. A.

541.126 3988

The sensitiveness of explosives. Copp, J. L., Napier, S. E., Nash, T., Powell, W. J., Skelly, H., Ubbelohde, A. R., and Woodward, P. *Philos. Trans. A*, **241**, 197–296 (*Aug.* 10, 1948).—I. The mechanism of initiation of detonation is discussed, and problems presented by the solid state (e.g. effect of shearing stress) are reviewed. Various conclusions are drawn from experimental work carried out in 1946. A theory of heat sensitiveness of initiators is presented. II. The delay to ignition and its temperature coefficient and the effect of compression on the sensitiveness of initiators are studied. Two mechanisms proposed for the build-up of detonation by solid explosives were tested by measuring the delay to detonation of lead azide. An account is given of experimental methods and results. III. The subjects studied are: (1) the grit sensitiveness of high explosives; (2) the sensitiveness of initiators to friction; (3) mechanical and thermal processes of initiation. IV. A statistical test for percussion sensitiveness of initiators (ball and disc machine) is described. A.

541.126 : 534.222.2 *see Abstr.* 3659

541.127 3989

The kinetic salt effect in monolayer reactions. Davies, J. T., and Rideal, E. K. *Proc. Roy. Soc. A*, **194** (*No.* 1039) 417–28 (1948).—The rate of hydrolysis of the ester group in the monocetylsuccinate ion by hydroxyl ion was studied as a monolayer reaction at various alkali strengths and in the presence of neutral salts. The Donnan equilibrium equations were used to calculate the concentration of the hydroxyl ions near the ester linkage, and the hydrolysis constants were found to show a very marked decrease in divergence when referred to the concentration of alkali in the surface, rather than that in the bulk phase. Activity coefficients of the ions in the surface phase were calculated and Brönsted's theory of specific ion interaction was extended to treat the case of the surface phase in the presence of added neutral salt. The slowing up of the alkaline hydrolysis of a neutral ester of a long-chain acid can also be quantitatively explained assuming the existence of a "surface phase," as can also the potential difference between the surface and the bulk. A.

541.128 : 541.67 : 538.27 *see Abstr.* 3837

ELECTROCHEMISTRY 541.13

541.132 = 4 3990

Dissociation of hydrogen molecules dissolved in water into free electrons and H^+-ions. Karpen, V. *C.R. Acad. Sci., Paris*, **226**, 1191–2 (*April* 12, 1948) *In French.*—The conductivity of water containing H_2 under a pressure of 0·5 atmosphere increases by about 100% in about 48 hours, but returns to its original value in four days after the H_2 is released. About one-fifth of the molecules must be dissociated into H^+-ions and electron and another fraction into atoms. C. B.

541.132 = 4 39

The possibility of existence of an ion $(H_3O)^+$. Sutra, *C.R. Acad. Sci., Paris*, **226**, 1194–5 (*April* 12, 1948) *French.*—From a recent study of the comparati mobilities of the H and D ions in heavy water [Abstr. 6 (1948)], it appeared that these ions were not hydrated very dilute solution. The contrary, however, is nc shown to be true in concentrated solutions. H. H. H

541.132.3 39

A feedback potentiometer for the measurement of *p*H values and oxidation-reduction potentials. Morton, *Trans. Faraday Soc.*, **44**, 588–96 (*Aug.*, 1948).—A the mionic valve feedback potentiometer is described. Th instrument has the advantage over *p*H meters of th deflection type that it may be calibrated in *p*H units in mV with any desired degree of accuracy, the calibratio being permanent and independent of the characteristi of the amplifier. The feedback potentiometer diffe from the potentiometric *p*H meters previously describe in the following respects: (1) The measurement entai only two adjustments. (2) If the feedback from th potentiometer is negative, these adjustments are stabilize to such a degree that a variation of ±10% in the supp voltage during the time occupied by the measureme introduces an error of less than ±1 mV or ±0·01 *p*H but when positive feedback is employed, high volta sensitivity (of the order of 40 mA/V) is obtained at th cost of decreased stability. (3) Automatic compensatio for variations in the e.m.f. of the electrodes due to change in the temperature of the solution is provided by mea of a thermistor (a bead of oxides 0·05 in. in dia.) im mersed in the solution; due to its small dimensions an low heat capacity, this element responds almost insta taneously to temperature changes and is capable of us when only a few drops of solution are available.

539.133 39

Molecular force fields. Heath, D. F., and Linnett J. W. *Trans. Faraday Soc.*, **44**, 556–68 (*Aug.*, 1948).— **I. The structure of the water molecule** (556–60).—Darlin and Dennison's potential energy function [Abstr. 116 (1940)] for the water molecule was transformed into function involving as variables the changes in the bon lengths and inter-bond angle. The form of this functio is discussed in relation to various structural factors in th water molecule. It is concluded that the most importan reason why the HOH angle in water >90° is becaus there is hybridization of the 2*s*-orbital of the oxyge atom with the 2*p*-orbitals in the formation of the O–H bonds. **II. The force fields of the tetrahalides of th group IV elements** (561–8).—The vibration frequencies o the tetrahalides of the Group IV elements are explained The same repulsion potential energy function can b used for all five tetrachlorides—and similarly for the fou tetrabromides. The magnitudes found for the first an second differentials of the repulsion p.e. function ar found to be reasonable if the repulsion is of a van de Waals type. The effect on the molecular structure of thes repulsions between the non-bonded atoms is discussed. A

541.135 : 538.569.3 : 537.226.2 *see Abstr.* 3756

541.135.2 = 4 39

A new experiment in electrolysis. Jolibois, P. *C.R Acad. Sci., Paris*, **226**, 1149–51 (*April* 12, 1948) *I French.*—An experiment is described to demonstrate th author's theory [*C.R. Acad. Sci., Paris*, **225**, 655 (1947) that the decomposition of a salt by electrolysis occurs no at the electrodes but at the surface of separation betwee

the solution and the solvent. Full details with diagram are included, together with a brief description of the cathodic and anodic phenomena. H. H. HO.

541.135.2 : 537.3.08 *see Abstr.* 3765

541.135.4 : 666.115 = 4 3995

A contribution to the study of electrolytic phenomena in glass. PEYSSOU, J. *Ann. Radioélectricité*, **3**, 107–14 (*April*, 1948) *In French.*—[Abstr. 3119 B (1948)].

541.136.24 = 4 3996

Hydrogen cells which borrow their energy from the surrounding medium. KARPEN, V. *C.R. Acad. Sci., Paris*, **226**, 1273–5 (*April* 19, 1948) *In French.*—It is shown that, as in every concentration cell, the minimum energy of H cells is entirely derived from the external medium, but that, contrary to the behaviour of other concentration cells, the gas concentrations at the electrodes return automatically to their initial values when the cell is maintained for some time at rest after use. H. H. HO.

541.139 : 538.69 = 4 3997

Magnetochemistry of germanium and its derivatives. PASCAL, P., PACAULT, A., AND TCHAKIRIAN, A. *C.R. Acad. Sci., Paris*, **226**, 849–51 (*March* 15, 1948) *In French.*—From measurements on Ge, GeO, GeO_2, GeS, GeS_2, $GeCl_4$, GeI_4, $GeCl_3Cs$, $Ge(C_2H_5)_4$, Ge (*iso*-$C_5H_{11})_4$, $Ge(C_6H_5)_4$, $Ge(C_6H_5S)_4$, and Ge_3N_4, values for χ_{Ge} are obtained by subtracting Pascal's values for the rest of the molecule. W. R. A.

PHOTOCHEMISTRY 541.14

541.14 3998

The photochemistry of selenium. I. The photochemical oxidation of hydrogen selenide. IVES, D. J. G., AND PITTMAN, R. W. *J. Chem. Soc.*, 766–9 (*June*, 1948).—It is shown that for the oxidation of H_2Se by gaseous oxygen the presence of liquid water is necessary. Also, that this reaction is promoted by light in the visible and the near ultraviolet and is autocatalysed by the production of solid Se. A.

541.14 : 539.169 *see Abstr.* 3925

541.141.12 3999

The photo-chemical decomposition of acetone at 3 130 Å. DORFMAN, L. M., AND NOYES, W. A., JR. *J. Chem. Phys.*, **16**, 557–60 (*June*, 1948).—The photochemical decomposition of gaseous acetone in light of 3 130 Å has been investigated at 26°c under conditions of high acetone pressure and low absorbed light intensities. The ratio C_2H_6/CO has been found to decrease substantially below unity at sufficiently low absorbed intensities, under which condition CH_4 has been found as a major product, exceeding the amount of C_2H_6 at very low intensities. A kinetic analysis of these data has shown that only a free radical process for the formation of C_2H_6 and CH_4 suffices to explain the experimental observations. The energy of activation for the reaction of a CH_3-radical with an acetone molecule to form CH_4 has been determined as $E = 6{\cdot}5$ kcal/mole. A.

COLLOIDS : DISPERSE SYSTEMS 541.18/.182

541.18.053 : 533.6.011 4000

The action and design of mechanical filters for dust and smoke. BIRSE, E. A. B., AND ROBERTS, J. K. *Trans. Faraday Soc.*, **44**, 273–8 (*May*, 1948).—A dust filter has been constructed consisting of a slit, through which the dust-laden air passes, and of two glass plates set parallel to the direction of flow of the air after passing through. The relation between the fraction of dust removed and the linear velocity of the air in the slit is determined for slits of various widths and for plates at varying distances apart. If the distance between the plates is fixed the fraction removed depends only on the linear velocity. The results are qualitatively discussed in terms of the theory of vortex formation. A.

541.182.4 4001

Oriented X-ray diffraction patterns produced by hydrous liquid crystals. MARSDEN, S. S., JR., AND MCBAIN, J. W. Letter in *J. Chem. Phys.*, **16**, 633 (*June*, 1948).

541.182.4 : 542.952 : 541.124 4002

Kinetics of emulsion polymerization. SMITH, W. V., AND EWART, R. H. *J. Chem. Phys.*, **16**, 592–9 (*June*, 1948).

541.182.5 : 533.583 : 537.531 4003

Physical studies of gel microstructure. SHULL, C. G., ELKIN, P. B., AND ROESS, L. C. *J. Amer. Chem. Soc.*, **70**, 1410–14 (*April*, 1948).—The micro-structure of 10 amorphous silica and silica-alumina gels has been obtained from investigation of low temperature gas adsorption, porosity, and small angle X-ray scattering. Correlation of results points to the validity of the method of calculation [Abstr. 3964 (1948)] in respect of these adsorbents. W. R. A.

ADSORPTION 541.183

541.183 4004

An examination of the adsorption theory of Brunauer, Emmett, and Teller, and Brunauer, Deming, Deming and Teller. GREGG, S. J., AND JACOBS, J. *Trans. Faraday Soc.*, **44**, 574–88 (*Aug.*, 1948).—The examination shows that: (1) The heat of adsorption E_1 calculated *via* the parameter c of the theory, is compatible with thermodynamic requirements as expressed in the Clausius–Clapeyron equation; (2) E_1 shows a moderate qualitative correspondence with the calorimetric or isosteric value, but close quantitative agreement is lacking; (3) the relationship which the theory implies between the integration constants of the vapour equation and the adsorption isostere does not hold in practice; (4) the assumption that the evaporation-condensation conditions of the adsorbed multilayer differ inappreciably from those of the bulk liquid is open to argument; (5) the implicit assumption that the adsorption isotherms above and below the critical temperature of the adsorbate are markedly different, is improbable; (6) the theory does not account for hysteresis, but the phase-change conception includes it as a natural consequence. A.

541.183 : 536.712 4005

Modifications of the Brunauer, Emmett and Teller equation. II. ANDERSON, R. B., AND HALL, W. K. *J. Amer. Chem. Soc.*, **70**, 1727–34 (*May*, 1948).—A modified B.E.T. equation has been derived and applied to physical adsorption isotherms of Types I and IV; it is believed that this equation provides a simple method of characterizing isotherms with four constants. The equation satisfactorily represents Type I isotherms provided that the free energy of adsorption in the second and subsequent layers is taken as equal to the heat of liquefaction. But with isotherms of Type IV which flatten below relative pressures of 0·85 satisfactory agreement with data results only if free energy of adsorption is taken as < heat of liquefaction. W. R. A.

541.183 : 539.233 = 4 4006

Theoretical basis of the coefficient (τ) of the rate of adsorption. MENNESSIER, A., BOUCHER, R., AND MONTIGNY, P. *C.R. Acad. Sci., Paris*, **226**, 1090–2 (*March* 31, 1948) *In French.*—An extension of Langmuir's theory of

monomolecular adsorption provides a theoretical basis for an experimentally determined coefficient (τ) of the rate of adsorption of benzene vapour on activated charcoal. (τ is defined in an earlier paper—*C.R. Acad. Sci., Paris*, **226**, 914 (1948)]. Under certain specified conditions the coefficient can be used to classify different adsorbing materials or catalysts as a function of their physical nature and consequently of their catalytic activity. J. I.

541.183.2 : 537.311.33 4007

Application of measurements of semi-conductivity to heterogeneous reactions. GRAY, T. J. Letter in *Nature, Lond.*, **162**, 260–1 (*Aug.* 14, 1948).—The resistance of semi-conducting cuprous oxide films was measured in presence of various gases (O_2, N_2, H_2, CO, He) at pressures between 10^{-3} and 0·3 mm of Hg. Considerable resistance changes were observed during the corresponding absorption and desorption processes. The measurements are repeatable above 200°C. H. K. H.

541.183.26 : 539.169 4008

Mixed adsorption of radon and argon on silica gel. BURTT, B. P., AND KURBATOV, J. D. *J. Amer. Chem. Soc.*, **70**, 2278–82 (*June*, 1948).—Using an apparatus which is described, the adsorption isotherms of air, argon, and carbon dioxide, alone and mixed with radon (1×10^{-16} g-atom at partial pressures approx. 1×10^{-10}) have been determined at 25° on silica gel; and also isotherms (25°) for mixtures of radioactive argon (A^{37}) with carbon dioxide and with air. Radon in air follows Henry's law and supports Langmuir's theory of mixed adsorption at low concentrations. Adsorption of radon is slightly enhanced in argon and slightly suppressed in carbon dioxide. Both in air and in carbon dioxide the heat of adsorption of radon is ~ 9 000 g-cals per mole. W. R. A.

541.183.26 : 539.217.1 *see Abstr.* 3964

ATOMIC THEORY 541.2

541.27 : 535.34 : 537.531 = 4 *see Abstr.* 3783

541.27 : 541.57 4009

Repulsive forces in relation to bond energies, distances and other properties. PITZER, K. S. *J. Amer. Chem. Soc.*, **70**, 2140–5 (*June*, 1948).—Energies of single and multiple bonds have been calculated from recent sources and are tabulated. The concept is of a balance within a chemical bond between attractive and repulsive forces both electronic in nature. In first row elements repulsive forces for single bonds arise chiefly in the valence shell, but in heavier atoms the inner shells play a predominant role. These ideas account qualitatively for the relative absence of multiple bonds except with first row elements, the large drop in bond energy from C–C to N–N, the failure of bond energies to predict Si–F, P–O and related bond distances, and the relative magnitude of barriers to internal rotation about single bonds. W. R. A.

CHEMICAL STRUCTURE 541.4/.6

541.5 : 539.13 *see Abstr.* 3847

541.57 : 535.347–15 *see Abstr.* 3699

541.57 : 539.133 4010

The energy of the C–H bond in the fluoro-toluenes. SZWARC, M., AND ROBERTS, J. S. *J. Chem. Phys.*, **16**, 609–11 (*June*, 1948).—In the pyrolysis of the three fluoro-toluenes the mechanism of the decomposition was found to correspond to that suggested previously for the decomposition of toluene and the xylenes. The C–H bond energy in all fluoro-toluenes is nearly the same a the C–H bond energy in toluene, i.e. about 78 kcal/mol thus showing that the field effect has very little influenc on the bond energy. This conclusion definitely establishe the presence of hyperconjugation for para-xylene as th cause of the weakening of the C–H bond in the CH groups. The difference in the effects of dipoles on ioni and radical reactions is pointed out.

541.57 : 541.27 *see Abstr.* 4009

541.57 : 541.62 401

Molecular association. HUNTER, L. *Research, Lond* **1**, 447–53 (*July*, 1948).—The mode of molecular associa tion is treated briefly under the following heading lattice structure of inorganic compounds, molecula arrangements in organic compounds, and associatin groups of which the principal ones are the OH, carboxy oximeino and amido. The role of the hydrogen atom i molecular association is dealt with at length, and th conclusion is drawn that there is a close connectio between the H-bond structure of the above organic type of compound and their tautomeric behaviour. Th suggestion is made that both the molecular associatio and the tautomerism are due to the intermolecula sharing of the H-atom. The significance of molecula weight data is discussed together with other conse quences of the H-bond. Steric factors in the operatio of H-bond association are considered, and H-bon lengths are assumed to be subject to considerabl variation as a result of them. H. H. HO

541.57 : 548.7 *see Abstr.* 4026–7

541.6 : 537.533.73 401

An electron diffraction investigation of the structure c adamantane. NOWACKI, W., AND HEDBERG, K. W *J. Amer. Chem. Soc.*, **70**, 1497–1500 (*April*, 1948).— The structural parameters derived from electron diffrac tion data on gaseous adamantane agree with those foun in the crystal. Assuming the symmetry $T_d - \bar{4}3m$ C–H = 1·09 Å and HCH angle = 109° 30′, the followin values are derived: C–C = 1·54 ± 0·01 Å and C_2C_3C angle = 109·5 ± 1·5°. W. R. A

541.6 : 539.133 *see Abstr.* 3857

541.62 : 539.13 *see Abstr.* 3848

541.62 : 541.57 *see Abstr.* 4011

541.64 401

On the degradation of long-chain molecules. II. JELLI NEK, H. H. G. *Trans. Faraday Soc.*, **44**, 345–9 (*June* 1948).—For Pt. I see Abstr. 2088 (1944).

541.64 : 532.133 : 532.72 *see Abstr.* 3640–1

541.65 : 535.343.9 = 82 *see Abstr.* 3696

541.66/.67 : 538.224 : 538.27 *see Abstr.* 3836

541.67: 538.224 *see Abstr.* 3833

541.67 : 541.128 : 538.27 *see Abstr.* 3837

CHEMICAL PROCESSES 542.9

542.942.3 : 539.167.3 *see Abstr.* 3923

542.952 : 541.124 : 541.182.4 *see Abstr.* 4002

CHEMICAL ANALYSIS 543/545

545.82 401

Spectrochemical analysis. TWYMAN, F. *Research Lond.*, **1**, 388–92 (*June*, 1948).—The methods available and the types of substance to which they may be applied are briefly reviewed. X-ray and infra-red spectroscop are included (18 refs.).

548.0 : 530.145.6 : 537.12 = 82 4015

The crystal as a multi-electron problem and a single-electron approximation. PEKAR, S. T. *J. Exp. Theor. Phys.*, **18**, 525–32 (*June*, 1948) *In Russian.*—It is shown that not every solution of Hartree's and Fock's equations makes physical sense, since these equations admit of many more solutions than the corresponding exact Schroedinger equation. The well-known self-consistent solution of the type $\psi_k(r) = u_k(r)\varepsilon^{ikr}$ will thus, in the majority of cases, be among those physically meaningless solutions. The paper gives self-consistent solutions having a physical meaning for these cases. In parallel with this, the treatment of the crystal as a multi-electron problem is carried through. A.

548.0 : 535.375 = 82 *see Abstr.* 3707

548.0 : 535.55 *see Abstr.* 3720

548.0 : 535.551 *see Abstr.* 3721

548.0 : 537.228.1 *see Abstr.* 3763

548.0 : 537.312.5 : 535.37 = 3 *see Abstr.* 3703

548.0 : 538.113 *see Abstr.* 3830

548.0 : 539.11 4016

Activation energy for the diffusion of coupled pairs of vacancies in alkali halide crystals. DIENES, G. J. *J. Chem. Phys.*, **16**, 620–32 (*June*, 1948).—The theoretical activation energy for the diffusion of neutral combined pairs of +ve and −ve ion vacancies in alkali halides was determined. Changes in Coulombic, repulsive, and polarization energies were taken into account. Calculations for the rigid and distorted lattice showed distortion effects during diffusion to be appreciable. This energy was estimated as accurately as possible near the saddle point. An activation energy of 0·375 eV was obtained for diffusion in the KCl lattice. This value shows that migration of neutral combined pairs of +ve and −ve ion vacancies, rather than diffusion via single vacancies, may well be the predominant process. It is concluded that diffusion by means of neutral combined pairs of vacancies is supported rather than prohibited by the theoretical results. A.

548.0 : 539.164.2 *see Abstr.* 3901

548.0 : 539.185 *see Abstr.* 3958

548.0 : 539.3 = 82 4017

The phenomenon of the artificial displacement. II. Nuclei of the artificial displacements. STEPANOV, A. V. *J. Exp. Theor. Phys.*, **18**, 741–9 (*Aug.*, 1948) *In Russian.*—Observations in polarized light are described referring to local disruption due to the action of a concentrated force on the surface of a NaCl crystal oriented in a certain way. Such a local disruption acts as a nucleus of displacements. The relation between the shape of the areas of disruption and the predictions of the theory of elasticity of anisotropic elastic solids is pointed out. The conditions and the mechanism of the formation of nuclei of displacement are indicated. A.

548.0 : 539.373 *see Abstr.* 3978

548.0 : 549.211 : 539.166.08 *see Abstr.* 3907

548.5 : 539.215 4018

Effect of recrystallized grain size on grain growth. BECK, P. A. *J. Appl. Phys.*, **19**, 507–9 (*May*, 1948).—See Abstr. 2983 (1948). The instantaneous rate of grain growth at a fixed temperature depends only on the grain size at that temperature. Limits to the validity of this result are discussed; and it is shown that isothermal grain growth in specimens starting from different recrystallized grain sizes has the same instantaneous rate at corresponding grain-size levels. L. S. G.

548.7 4019

Atomic displacements in the austenite–martensite transformation. JASWON, M. A., AND WHEELER, J. A. *Acta Cryst.*, **1**, 216–24 (*Sept.*, 1948).—The displacements are described, and the strains involved are derived. It is shown that the tetragonality of martensite arises as a necessary consequence of the assumption that the Fe and C atom displacements constitute a common homogeneous deformation. An explanation of the observed high indices of the habit plane of martensite of certain C contents is advanced. A.

548.7 = 3 4020

The crystal structure of crystalline hydroxides. FRICKE, R. *Z. Naturforsch.*, **3a**, 62 (*Jan.*, 1948) *In German.*—It is argued that it is incorrect to regard the OH′ ion as easily polarizable in all circumstances since the layer lattice type of structure, contrary to previously held opinions, does not invariably occur for all hydroxides. Several instances are quoted in which the OH′ ions are linked in 3-dimensional co-ordination with neighbouring metallic ions. In $Y(OH)_3$, $Sc(OH)_3$ and $In(OH)_3$, which crystallize in the cubic system, it is considered that the O ions are linked by H bonds. J. T.

548.7 : 519.2 4021

Approximate configurational partition functions for certain aggregates of spherical molecules. MORALES, M. F., AND BOTTS, J. *J. Chem. Phys.*, **16**, 587–91 (*June*, 1948).—There are calculated by two different methods the number of ways in which i sites out of a total of n sites may be filled in such a manner that among the filled sites there will be p nearest neighbour pairs when the sites form certain regular spherical surface lattices: the contact points on any sphere in the cubic and hexagonal closest packings of spheres, and in the simple cubic packing of spheres. The use of these results in the treatment of a model of antibody-antigen combinations is briefly indicated. A.

548.7 : 534.13 4022

Infra-red vibrations in NaCl. MARKHAM, J. J. *J. Chem. Phys.*, **16**, 580–6 (*June*, 1948).—A detailed calculation has been made of the propagation properties of the lattice vibrations in NaCl. The phase velocity, the group velocity, displacement angle (angle between the particle displacement and the direction of propagation), and the displacement ratio were calculated for three directions of propagation on Born's theory. The crystal has a low pass (acoustical) and at times overlapping upper band (optical). At the lowest frequency the waves are simply elastic ones. As the frequency increases, the structure exhibits strong dispersion. The optical branch is highly dispersive at all frequencies. The group velocity is negative (on the single-zone scheme), and approaches zero at both the short and long wavelength limits. A.

548.7 : 535.375.5 4023

The theory of the vibrations and the Raman spectrum of the diamond lattice. SMITH, H. M. J. *Philos. Trans. A*, **241**, 105–45 (*July* 6, 1948).—Born's general theory [*Rep. Progr. Phys.*, **9**, 242 (1942)] is applied. Arbitrary forces between first-neighbour atoms and central forces between second-neighbour atoms are assumed, the values of the force constants being obtained from the measured elastic constants and the frequency shift of the principal Raman line. Approxns are derived for the quasi-continuous vibrational spectrum of the diamond, and the specific heat and Debye's characteristic temperature are calculated. Comparison with observed specific heat shows that first-neighbour forces alone are not sufficient to account

for the experimental results, but the addition of central second-neighbour forces produces agreement. The second-order Raman spectrum [Abstr. 2580 (1944)] is calculated from the vibrational spectrum. The relative intensities of the parts of the spectrum are explained upon postulating certain relations between coupling constants; and these relations allow further differences between the electronic configurations in the two types of diamond to be investigated.

548.7 : 535.375.5 = 4 *see Abstr.* 3710–11

548.7 : 535.375.5 = 5 *see Abstr.* 3712

548.7 : 537.531 = 4 *see Abstr.* 3785

548.7 : 539.11 = 82 *see Abstr.* 3845

548.7 : 539.181.71 = 3 4024

The theory of anomalous atom beam reflexion at crystal surfaces. I–II. ARTMANN, K. *Z. Phys.*, **118** (*Nos* 9–10) 624–58; (*Nos* 11–12) 659–76 (1942) *In German.*—When He atom beams impinge on a LiF crystal surface the intensity of the reflected beam depends on the angle of the beam w.r. to the crystal axes, intensity "troughs" occurring at definite angles due to the van der Waals' forces. An optical calculation method is used to explain this anomalous reflection, and the van der Waals' attraction forces and the crystal surface inhomogeneity are deduced. A crystal model with discontinuous potential function is postulated, and the theoretical position of the "troughs" corresponds with Stern's experiments. The shape of the "troughs," however, is predicted wrongly. Contrary to experimental evidence the theory predicts flat troughs for low incidence and deep troughs for steep incidence angles. V. W. R.

548.7 : 539.411/.412 = 82 4025

Tenacity of crystal lattices. ZHDANOV, V., AND TIKHONOVA, L. *J. Exp. Theor. Phys.*, **18**, 552–8 (*June*, 1948) *In Russian.*—The tenacity of a 1-atomic cubic face-centred crystal lattice in unilateral tension and compression is considered, and the intrinsic difference of tensile and compressive disruption is shown. Evidence of this is found in the considerably smaller resistance of the lattice to compression than to tensile stress. A.

548.7 : 541.57 4026

A new interpretation of interstitial compounds—metallic carbides, nitrides and oxides of composition *MX*. RUNDLE, R. E. *Acta Cryst.*, **1**, 180–7 (*Sept.*, 1948).—Evidence is cited to show that interstitial monocarbides, mononitrides and a few monoxides tend to have the NaCl structure irrespective of metal structure and metal radius. The need for important metal/non-metal bonds to explain the physical properties of the interstitial phases is pointed out. Interstitial phases are regarded as electron-deficient structures, where the non-metal forms more bonds than it has bond orbitals. It is suggested that hybrid *sp*-orbitals combined with *p*-orbitals are used by the non-metal in bonds to metal. A single *p*-orbital is used to form two bonds at 180°, but the two bonds or half-bonds contain only one electron pair. Resonance of *sp* and *p* bonds leads to octahedral bonding by the non-metal. The concept of half-bonds is used to explain the structure, hardness, brittleness, conductivity and high melting-points of interstitial phases with the NaCl-type structure, and a few other interstitial types. The conditions for forming half-bonds are discussed, and it is concluded that they may be formed between the non-metals, H, B, C, N and possibly O and the less electropositive *A*-group metals. Only in the case of C, N and O is octahedral bonding and the NaCl-type structure to be expected on the basis of the proposal. A.

548.7 : 541.57 402

The nature of the bonds in the iron silicide FeSi and related crystals. PAULING, L., AND SOLDATE, A. M. *Acta Cryst.*, **1**, 212–16 (*Sept.*, 1948).—FeSi was re investigated by X-ray photography of single crystals, and the reported structure for the substance was verified. The space group is T^4–$P2_13$, with $a_0 = 4{\cdot}489 \pm 0{\cdot}005$ Å. Four Fe atoms and four Si atoms are in position $(x, x, x;\ x+\frac{1}{2}, \frac{1}{2}-x, \bar{x};\ \swarrow)$, with $x_{Fe} = 0{\cdot}1370 \pm 0{\cdot}0020$ and $x_{Si} = 0{\cdot}842 \pm 0{\cdot}004$. A detailed discussion of the structure and the values of the interatomic distances is given, by application of the resonating valence-bond theory, and it is shown that the interatomic distances are compatible with those found for elementary Fe and elementary Si. A

548.73 402

A versatile technique for X-ray single crystal structure analysis applied to benzaldehyde-2 : 4-dinitrophenylhydrazone and zinc salts of salicylic and benzoic acids. CLARK, G. L., AND KAO, H. *J. Amer. Chem. Soc.*, **70** 2151–4 (*June*, 1948).—By a combination of the equi-inclination Weissenberg and the Buerger precession methods a simple procedure, particularly suitable for single needle crystals, has been developed and used to determine the crystal habits, densities, and probable space groups of benzaldehyde-2 : 4-dinitrophenylhydrazone, zinc salicylate trihydrate, zinc benzoate, and zinc hydrogen benzoate dihydrate. W. R. A.

548.73 402

X-ray scattering by thermal vibrations in crystals. LONSDALE, K. Letter in *Nature, Lond.*, **162**, 216 (*Aug.* 7 1948).—Raman's statements [Abstr. 3524 (1948)] are disputed. Geometric diffraction patterns due to elastic vibrations have been obtained with Na, Pb and W, and explained on the theory; eigen-vibration theory can offer no explanations.

548.73 403

Crystal structure of nitronium perchlorate. COX, E. G., JEFFREY, G. A., AND TRUTER, M. R. Letter in *Nature, Lond.*, **162**, 259 (*Aug.* 14, 1948).—The crystals [Abstr. 3229 (1946)] are monoclinic, unit cell has $a = 9{\cdot}25$, $b = 6{\cdot}99$, $c = 7{\cdot}34$ Å, $\beta = 113{\cdot}5°$, 4 molecules of $NClO_6$, with ions NO_2^+ and ClO_4^-. Space group $C2/c$, the N and Cl atoms lying on the twofold axes, the O atoms being in general positions. The NO_2^+ ion is linear, with N–O $\simeq 1{\cdot}1$ Å; the ClO_4^- ion is $\sim$ tetrahedral, with Cl–O $\simeq 1{\cdot}5$ Å.

548.73 : 535.41 : 535.37 403

X-ray diffraction studies of systems involved in the preparation of alkaline earth sulphide and selenide phosphors. PRIMAK, W., KAUFMAN, H., AND WARD, R. *J. Amer. Chem. Soc.*, **70**, 2043–6 (*June*, 1948).—Precision lattice constants were determined for MgS, CaS, SrS, SrSe, CaO and MgO. The extent of solid solution among them has been investigated. Whereas complete intersolubility exists between CaS, SrS and SrSe, MgS and CaS are only intersoluble over a limited range. Among the other pairs solid solution formation is negligible. W. R. A.

548.73/.74 : 535.42 403

An optical analogue of X-ray and electron diffraction patterns. DYSON, J. Letter in *Nature, Lond.*, **162**, 140–1 (*July* 24, 1948).—An experimental technique is described for studying the correspondence between the bubble model [Abstr. 3358 (1947)] of the atomic sites in a crystal lattice and the actual degree of order in the crystal. The pattern derived is more closely related to those obtained by electron diffraction than by X-rays. The experiments

were carried out with bubble rafts; each bubble image acts as a scattering centre and diffracts light with a polar diagram depending on its geometry and contrast.

548.733 4033

Multiple Guinier cameras. DE WOLFF, P. M. *Acta Cryst.*, **1**, 207–11 (*Sept.*, 1948).—The camera described is characterized by a combination of several cameras in a compact unit using a single focusing monochromator and a single film, and by the disposition of the camera relative to the monochromator in such a manner that α-doublet diffraction lines coincide for a θ value of, say, 15°. In this way an exceptionally high resolving power is obtained in a considerable range of glancing angles, centred about this value, which contains the most selective lines for analytical purposes. The line width in the respective cameras is discussed, and the conclusion is reached that in the significant region $\theta < 30°$ there is no appreciable difference between the outer and the middle cameras of the unit. With a view to comparison purposes, the line shift for the outer cameras is also calculated; it appears to be of little consequence. Finally, short descriptions of a twofold and of a fourfold camera are given. A.

548.734.2 4034

Indexing of Laue photographs of cubic crystals. LONSDALE, K. *Acta Cryst.*, **1**, 225 (*Sept.*, 1948).

548.734.3 4035

Indexing powder photographs of tetragonal, hexagonal and orthorhombic crystals. HESSE, R. *Acta Cryst.*, **1**, 200–7 (*Sept.*, 1948).—A numerical method of indexing without the use of single-crystal data is described. The method leads to a fairly systematic treatment of tetragonal and hexagonal photographs, and has also proved valuable in orthorhombic cases. A.

548.735 4036

Convenient methods for obtaining d/n values from X-ray diffraction patterns. STEWART, C. B., AND LUTTON, E. S. *J. Appl. Phys.*, **19**, 507 (*May*, 1948).—Accurate relations [Abstr. 653 (1948)] are given for rapid sliderule calculation for flat films and cylindrical films. L. S. G.

548.735.4 4037

Evaluation of Fourier transforms by a Fourier synthesis method. WHITTAKER, E. J. W. *Acta Cryst.*, **1**, 165–7 (*Sept.*, 1948).—A convenient numerical method is developed using the Beevers–Lipson strips. A detailed procedure is worked out for the determination of the radial distribution curve of an amorphous material from the X-ray diffraction intensity curve, but the method is generally applicable provided that the transformed function is continuous and approaches zero sufficiently rapidly. For the purpose considered, strips giving values of $A \sin 2\pi nx$ at intervals of $\frac{1}{120}$ in x to two-figure accuracy and extending up to the 45th harmonic are shown to be suitable. The accuracy of the method has been tested by evaluating the transforms of the first three odd Hermite functions with satisfactory results. A.

548.735.4 4038

The application of the Harker–Kasper method of phase determination. GILLIS, J. *Acta Cryst.*, **1**, 174–9 (*Sept.*, 1948).—The Harker–Kasper inequalities and related ones are applied to the data on oxalic acid dihydrate. The technique of obtaining some 40 signs of the structure amplitudes is developed in detail. Some general remarks on the method conclude the paper. A.

548.735.4 4039

A numerical Fourier-analysis method for the correction of widths and shapes of lines on X-ray powder photographs. STOKES, A. R. *Proc. Phys. Soc., Lond.*, **61**, 382–91 (*Oct.*, 1948).—A method is derived, using Fourier analysis, for finding the corrected distribution of intensity across an X-ray diffraction line, and the procedure is illustrated by a numerical example. The method may also be of use in spectrum analysis and statistical problems. A.

548.735.46 4040

The accuracy of electron-density maps in X-ray structure analysis. COX, E. G., AND CRUICKSHANK, D. W. J. *Acta Cryst.*, **1**, 92–3 (*May*, 1948).—The random errors in electron density maps are due to the method of correction for finite series, experimental errors and rounding off errors in computation. Formulae are given for the standard deviations (s.d.) of the errors in the electron density, its slopes and second differentials, arising from the experimental and finite series correction errors in three dimensional syntheses. The s.d.'s of a peak position are obtained using Booth's differential equations for peak positions [Abstr. 1050 (1947)]. A significance test is derived from error functions. The method is illustrated by examining the central C–C bonds in dibenzyl. J. A. F.

548.736 4041

Crystal structure of element 43. MOONEY, R. C. L. *Acta Cryst.*, **1**, 161–2 (*Sept.*, 1948).—Powder diffraction patterns were obtained from microgram quantities of the long-lived isotope, Tc^{99}, of element 43. Like Re, Os and Ru, Tc crystallizes in the hexagonal close-packed arrangement. The cell, which contains two atoms, has the following dimensions: $a_1 = 2{\cdot}735 \pm 0{\cdot}001$ Å., $a_3 = 4{\cdot}388 \pm 0{\cdot}001$ Å., $a_3/a_1 = 1{\cdot}604$. The calculated density, based on an atomic weight of 99, is $11{\cdot}497$ g.cm^{-3}. Each atom has twelve neighbours, six at 2·735 Å and six at 2·698 Å. A.

548.736.32 4042

A note on the structure of nickel oxide at subnormal and elevated temperatures. ROOKSBY, H. P. *Acta Cryst.*, **1**, 226 (*Sept.*, 1948).

548.736.42 4043

X-ray diffraction analysis of indium hydroxide and "indium chromate." PALM, A. *J. Phys. Coll. Chem.*, **52**, 959–61 (*June*, 1948).—X-ray diffraction data indicate that the yellow compound precipitated upon the addition of chromate to indium chloride has a crystalline structure identical with that of indium hydroxide, and furnish further evidence for the fact that no indium chromate is precipitated in this reaction. The cubic crystal structure of $In(OH)_3$ has a lattice constant of $7{\cdot}90 \pm 0{\cdot}04$ Å. A.

548.736.432 4044

The crystal structure of sodium selenochromite, $NaCrSe_2$, and preliminary investigations on related compounds. RÜDORFF, W., RUSTON, W. R., AND SCHERHAUFER, A. *Acta Cryst.*, **1**, 196–200 (*Sept.*, 1948).—Attempts were made to prepare new model-substances for magneto-chemical investigations. $NaCrSe_2$, $RbCrSe_2$, and $RbCrS_2$, of high purity were prepared by reaction of the pure elements, and $K_{0\cdot5}CrSe_2$ or $KCrSe_2 \cdot CrSe_2$, by fusion of KCN with Cr_2O_3 and Se. The crystal structures were investigated with the following results. $NaCrSe_2$: hexagonal rhombohedric; $D_{3d}^5 - R\bar{3}m$; $I_a = 3{\cdot}708$, $I_c = 20{\cdot}29$ Å $\pm$ 0·05 Å; parameter z of Se: 95·3° $\pm$ 0·3°; density obs. = $4{\cdot}49_7$ g.cm^{-3}; density calc. = $4{\cdot}77$ g.cm^{-3}; the hexagonal unit cell contains three, the rhombohedral cell one molecule of $NaCrSe_2$. $K_{0\cdot5}CrSe_2$: hexagonal rhombohedric; $C_{3v}^5 - R3m$; $I_a = 3{\cdot}44$ Å, $I_c = 24{\cdot}2$ Å; parameter z of Se: 141·5°; parameter z of K: 60–62°. $RbCrSe_2$: hexagonal rhombohedric; $I_a = 3{\cdot}34$ Å, $I_c = 26{\cdot}9$ Å; density obs. = $5{\cdot}02$ g.cm^{-3}, density calc. = $5{\cdot}26$ g.cm^{-3}. $RbCrS_2$: hexagonal rhombohedric; $I_a = 3{\cdot}39$ Å, $I_c = 16{\cdot}20$ Å. The radius of the Se^{2-} ions decreases from 1·85 Å in $NaCrSe_2$ to $1{\cdot}71_5$ Å in

$RbCrSe_2$. Preliminary magnetic measurements on $NaCrSe_2$ show the compound to obey the Curie–Weiss law with a θ value of about $+70°$C. A.

548.736.442 4045

The crystal structure of hexagonal barium titanate. EVANS, H. T., JR., AND BURBANK, R. D. Letter in *J. Chem. Phys.*, **16**, 634 (*June*, 1948).

548.736.452 4046

Crystal structure of tetragonal bismuth arsenate, $BiAsO_4$. MOONEY, R. C. L. *Acta Cryst.*, **1**, 163–5 (*Sept.*, 1948).—The complete crystal structure was determined by X-rays. The crystal has the scheelite structure. The body-centred cell, containing four molecules, has the following dimensions: $a = 5{\cdot}08 \pm 0{\cdot}02$ Å; $c = 11{\cdot}70 \pm 0{\cdot}02$ Å; $c/a = 2{\cdot}30$. The calculated density is $7{\cdot}6$ g/cm^3. The space group is $C_{4h}^6 - I4_1/a$. The As and Bi atoms are in fourfold special positions (*a*) and (*b*) of the space group, while the O atoms are in the sixteenfold general positions (*f*). The O parameters, given in fractions of the unit cell, are $x = 0{\cdot}213$; $y = 0{\cdot}149$; $z = 0{\cdot}080$. Bi is in eight co-ordination, the average Bi–O distance being 2·54 Å. A.

548.737 4047

Some X-ray measurements on single crystals of tomato bushy-stunt virus. CARLISLE, C. H., AND DORNBERGER, K. *Acta Cryst.*, **1**, 194–6 (*Sept.*, 1948).—X-ray measurements on single crystals of tomato bushy-stunt virus have confirmed that the crystal is cubic body-centred with a cell side of 386 Å for the wet and 314 Å for the dry state. Owing to the large unit cell of the crystal there are many crystallographic planes in a stationary crystal in position to reflect monochromatic X-rays, thus giving rise to photograph showing concentric rings of discrete reflections when the X-ray beam is travelling parallel to a crystallographic axis. From such photographs it can be shown that both the Bravais lattice and the cell side can be simultaneously determined for the wet crystal without the need of resorting to oscillation or rotation photographs. It is found that the "ring" effect has completely disappeared in the dry state, and instead the appearance of reflections near the centre of the photograph suggests that a slight disorientation of internal crystallite regions has possibly taken place. The experiments indicate the necessity for the use of high-intensity sources of X-rays for work on weakly scattering biological materials. A.

548.737 4048

The space group of phenanthrene. BASAK, B. S. *Acta Cryst.*, **1**, 224 (*Sept.*, 1948).

548.74 : 621.314.632 4049

Electron diffraction and rectification from silicon and pyrite surfaces. COWLEY, J. M., AND SYMONDS, J. L. *Trans. Faraday Soc.*, **44**, 53–60 (*Jan.–Feb.*, 1948).—[Abstr. 2965 B (1948)].

MINERALOGY 549

549.211 : 548.0 : 539.166.08 *see Abstr.* 3907

GEOPHYSICS 55

550.312 4050

Gravity anomalies in Northwestern Canada. INNES, M. J. S. *Canad. J. Res. A*, **26**, 199–203 (*May*, 1948).—Free air, Bouguer, and isostatic anomalies are listed in a table of principal facts for 23 stations between latitudes 55° and 70°. There is some evidence that the predominantly negative anomalies at stations in the Pre-Cambrian may be due to lack of isostatic adjustment following removal of glacial loads. A.

550.342 : 534.222.1 4051

A theory of microseisms with geologic applications. PRESS, F., AND EWING, M. *Trans. Amer. Geophys. Un.*, **29**, 163–74 (*April*, 1948).—A theory for the origin of microseisms based on the normal mode propagation of sound in two layers is given. It explains the mechanism of transmission of seismic energy from a storm at sea and predicts that periods of three to nine sec will predominate, depending on the depth of the water and the elastic properties of the bottom. It is shown that this theory can be used to infer elastic properties of the ocean bottom, to a depth of the order of several times the depth of the water, by a study of the periods of microseisms originating from storms whose positions are known. A.

550.36/.367 4052

Von Zeipel's theorem and convection in the earth. VERHOOGEN, J. *Trans. Amer. Geophys. Un.*, **29**, 361–5 (*June*, 1948).—A theorem of astrophysics may be applied to the earth and leads to the conclusion that the distribution of radioactive matter is probably such that the temperature is not the same at all points on a level surface inside the earth. These differences in temperature might give rise to convection currents that circulate in meridional planes. The velocity of these currents cannot be estimated for want of data on the actual distribution of temperature, but it may be a few centimetres per year. A.

550.361 = 3 405

The temperature gradient at the earth's surface and the radioactive heat-production in the earth's crust. JUNG, K. *Naturwiss.*, **34** (*No.* 7) 213–14 (1947) *In German.*—Jeffreys' calculations give too low a value for the content of radio-active material in the earth's crust. It is suggested that he chose initial conditions that are unsuitable. W. A. R.

550.383 405

The radial variation of the earth's magnetic field. RUNCORN, S. K. Appendix by CHAPMAN, S. *Proc. Phys. Soc., Lond.*, **61**, 373–82 (*Oct.*, 1948).—It is shown that core and distributed theories of the earth's magnetic field predict different variations of field intensity with depth. Whereas on core theories both the horizontal and vertical intensities increase with depth according to an inverse cube law, on a distributed theory such as the one recently put forward by Blackett we find, with reasonable assumptions, that while the vertical intensity should increase for small depths as an inverse cube law, the horizontal intensity should decrease. The difference between the theories is even more marked deep inside the earth. It is also suggested that if the variation-with-depth experiment gives a positive result in favour of distributed theories, then experiments on the magnetic effect of gorges in the earth's surface might throw further light on the mechanism of the phenomena. A.

550.83 405

The search for minerals by physical methods. RANKINE, A. O. *J. Inst. Met.*, **74**, 563–82 (*July*, 1948).—An account given, as the May lecture, 1948, of the methods of geophysical prospecting used, in co-operation with economic geology, in determining location and depth of potentially oil-bearing rock structures prior to drilling. Gravitational and seismic surveying are treated

in greater detail with an assessment of the relative merits of the instruments employed, as these are the preferred methods in the search for oil, the main field of application of these methods. Possibilities of geophysical prospecting for minerals other than oil also touched on. No bibliography.

550.837.7 4056

The attenuation of ultra-high frequency electromagnetic radiation by rocks. COOPER, R. I. B. *Proc. Phys. Soc., Lond.*, **61**, 40–7 (*July*, 1948).—Radiation of frequency 200 Mc/s was transmitted through the covering rocks of certain railway tunnels, the object being to measure the attenuation of rocks *in situ* to see if there might be practical applications to geophysical prospecting. The attenuation in dry sandstone was found to be 3 to 4 db per foot, and it thus appears that the penetration is insufficient to be of practical use. A.

551.465 4057

The westward intensification of wind-driven ocean currents. STOMMEL, H. *Trans. Amer. Geophys. Un.*, **29**, 202–6 (*April*, 1948).—A study is made of the wind-driven circulation in a homogeneous rectangular ocean under the influence of surface wind stress, linearized bottom friction, horizontal pressure gradients caused by a variable surface height, and Coriolis force. An intense crowding of streamlines toward the western border of the ocean is discovered to be caused by variation of the Coriolis parameter with latitude. It is suggested that this process is the main reason for the formation of the intense currents (Gulf Stream and others) observed in the actual oceans. A.

ATMOSPHERE . METEOROLOGY 551.5

551.505.77 : 621.396.91 4058

The use of radar in determining the amount of rain falling over a small area. BYERS, H. R., AND COLLABORATORS. *Trans. Amer. Geophys. Un.*, **29**, 187–96 (*April*, 1948).—Radar storm echoes are compared with rainfall recorded by a battery of 55 sensitive rain gauges located ~ 1 mile apart. For thunderstorms it is found that the areas of rainfall can be determined with accuracy by the radar. A single radar set can measure quantitatively thunderstorm rainfall that would be missed completely by existing rain-gauge nets. If properly "calibrated" against a battery of rain gauges, the radar can measure rainfall about as accurately as would be possible from a micronetwork of rain gauges such as was used in these tests. A.

551.508 : 621.396.91 4059

Direction finder for locating storms. KESSLER, W. J., AND KNOWLES, H. L. *Electronics*, **21**, 106–10 (*May*, 1948).—[Abstr. 2882 B (1948)].

551.510.4 : 551.577 4060

The growth of particles in smokes and clouds and the production of snow from supercooled clouds. LANGMUIR, I. *Proc. Amer. Phil. Soc.*, **92**, 167–85 (*July* 19, 1948).—An address in which an account is given of research into (1) the production and properties of smoke screens, and (2) the problem of whether it is possible to remove icing conditions for aircraft by converting all supercooled water clouds into ice crystals. Chain reactions occurring during snowstorms and a theory of the growth of rain are discussed.

551.510.535 4061

Atmospheric tides in the ionosphere. III. Lunar tidal variations at Canberra. MARTYN, D. F. *Proc. Roy. Soc. A*, **194** (*No.* 1039) 429–44 (1948).—For previous work see Abstr. 1072, 2338 (1947). Semi-diurnal lunar variations were found in the heights and critical layers of the E, F_1 and F_2 regions, and the harmonic coefficients were determined. From the study of these it is concluded: (*a*) that ionospheric lunar variations are caused by ionic drift under the action of the "dynamo" electric forces, and not by simple tidal rise and fall of isobaric surfaces; (*b*) that the lunar magnetic variations are not produced in the E, F_1 or F_2 regions. A.

551.510.535 4062

Atmospheric tides in the ionosphere. IV. Studies of the solar tide, and the location of the regions producing the diurnal magnetic variations. MARTYN, D. F. *Proc. Roy. Soc. A*, **194** (*No.* 1039) 445–63 (1948).—Solar tidal effects are sought in ionospheric data from representative latitudes. They are found in the E, F_1 and F_2 regions. For the F_2 region the seasonal semi-diurnal harmonics arising from P_3^2 are comparable with those from P_2^2. The amplitudes and phases of these harmonics are determined, and they are used to interpret the global distribution of F_2 ionization. Evidence is found that the lunar magnetic variation is produced mainly by currents in the D region of the ionosphere, but is opposed by the corresponding currents in the E and F_1 regions. This finding is submitted to an independent test, using McNish's evidence of the effects of solar flares on the magnetic variation. A.

551.510.535 4063

Solar eclipse observations of the ionosphere. MCLEISH, C. W. *Canad. J. Res. A*, **26**, 137–44 (*May*, 1948).—The results are presented of measurements made in the region of totality during the eclipse of July 9, 1945. An analysis of the results shows effective recombination coefficients of $1{\cdot}6\times10^{-8}$ for E region, $1{\cdot}4\times10^{-8}$ for F_1 region, and $1{\cdot}0\times10^{-9}$ for F_2 region. Evidence of a variable coefficient for the E region agrees with the suggestion of Massey and others of a high negative ion density at this level. A.

551.510.535 : 551.594.12 *see Abstr.* 4074

551.510.535 : 621.314.26 4064

Ionosphere reflections recorded mechanically by means of a repetition frequency converter. STOFFREGEN, W. *J. Appl. Phys.*, **19**, 487–90 (*May*, 1948).—A method of converting the high repetition frequency used by echo sounding to a lower value by means of a converter between the receiver and the recorder is described. The method is adapted to recordings of radio-echoes from the ionosphere, in which case the repetition frequency of 50 c/s of the pulse transmission after reception is converted into a repetition frequency of $\frac{1}{2}$–$\frac{1}{3}$ c/s before being supplied to the recorder. Ionosphere echoes having a delay of the order of milliseconds and a pulse width of ~ 20–100 μsec may thus be recorded mechanically. The principle of repetition frequency conversion described may find applications in recording ultrasonic or radar reflections. A.

551.510.535 : 621.396.11 = 393 4065

Significance of the state of the ionosphere for long-distance radio-communication. GROENEWOLD, H. J. *Tijdschr. Ned. Radiogenoot.*, **13**, 103–29 (*July*, 1948) *In Dutch.*—[Abstr. 3084 B (1948)].

551.521 : 551.578.46 4066

Penetration of radiation into the snow pack. GERDEL, R. W. *Trans. Amer. Geophys. Un.*, **29**, 366–74 (*June*, 1948).—A very sensitive pyrheliometer was designed and constructed by the author for measurement of the quantity of radiation transmitted through a snow pack. During March 1947, measurements of radiation transmission through the snow were made with this pyrheliometer at the Central Sierra Snow Laboratory. It was

found that the depth to which radiation was transmitted increased as snow density increased. Absorption coefficients were obtained for snow between 26 and 40% density. The presence of ice and slush in the snow surface resulted in a decreased albedo and increase in the amount of radiation absorbed. However, there was approximately 50% reduction in the amount of radiation transmitted through the ice and slush layer to lower horizons in the snow. A.

551.521 : 551.593 : 535.232 = 3 4067

Spectral energy distribution in skylight and sunlight. GÖTZ, F. W. P., AND SCHÖNMANN, E. *Helv. Phys. Acta*, **21** (*No.* 2) 151–68 (1948) *In German.*—Gives the results of measurements, made with a quartz spectrograph, of the energy distribution between about 325 and 530 mμ for sunlight and for zenith skylight with the sun at various elevations. Measurements were also made for different degrees of haze and the results are compared with those obtained on Mie's theory of scattering by fine particles. J. W. T. W.

551.521.14 4068

The albedo of the ground and atmosphere. FRITZ, S. *Bull. Amer. Met. Soc.*, **29**, 303–12 (*June*, 1948).—Measurements of the upward and downward components of solar radiation were measured from an aeroplane. From these the albedo of the ground has been calculated. In the centre of the country along the 39th parallel of latitude, the albedo of the ground, except when covered in part by snow, was found to be between 0·07 and 0·10. As the Western Mountains were approached, the albedo increased to 0·12. In the mountains, where the colour of the terrain varies rapidly, the albedo reached a high value of 0·23, and averaged about 0·17. For terrain which was partially snow-covered the highest albedo measured was 0·29. Computations were made which showed the absorption of solar radiation to be about 0·06 ly/min in a unit column reaching from the ground to 10 000 ft which by itself would cause a temperature rise of 0·05°c/hr in a cloudless smoky atmosphere. A.

551.576 : 551.594.11 *see Abstr.* 4073

551.577 : 551.510.4 *see Abstr.* 4060

551.578.46 : 551.521 *see Abstr.* 4066

551.593 : 535.232 : 551.521 = 3 *see Abstr.* 4067

551.593.5 : 525.735 = 4 4069

Results of new researches on the shadow of the earth. DUBOIS, J. *C.R. Acad. Sci., Paris*, **226**, 1180–3 (*April* 12, 1948) *In French.*—Spectrophotometric measures in the visual of the ratio $\log B_\lambda/E_\lambda$ (B_λ, the brightness near summit of the anti-twilight arc; E_λ, solar illumination outside atmosphere) exhibit maxima at λ = 4 620, 4 890, 5 050, 5 750, 6 010, 6 250 Å with pronounced minimum at 5 895 Å. Excepting max. at 6 250 Å (due to O_2), observed variations of ratio with λ follow those of absorption coefficient of O_3, implying that anti-twilight arc results from direct absorption of O_3 rather than from encroaching earth's shadow. D. R. B.

551.593.5 : 778.3 *see Abstr.* 4086

551.593.51 : 525.75 = 4 4070

Excitation of the green line of oxygen at twilight. DUFAY, J., AND DUFAY, M. *C.R. Acad. Sci., Paris*, **226**, 1208–10 (*April* 12, 1948) *In French.*—Spectrograms of the W. twilight sky (at Z.D. 73°) show marked weakening of the 5 577 Å O emission during late twilight, the initial intensity being about twice that after nightfall. As distinct from twilight strengthening of O emissions at 6 300, 6 364 Å, due to optical resonance, the enhanced green emission is attributed to fluorescence excited directly by solar radiation at 2 972 Å. D. R. B.

551.593.9 407

Thickness and height of the sodium layer responsible for the strong yellow line in twilight. VEGARD, L. Letter in *Nature, Lond.*, **162**, 300 (*Aug.* 21, 1948).—Recent spectrographic determinations of the effective upper limit of the Na layer, and of the atmospheric screening-height, placed these at 110 and 49 km respectively. No regular annual variation of either has so far been detected. The observed thickness of the Na layer varies seasonally with maxima ~28 km at the equinoxes and a minimum of 8 km near the winter solstice. The Na layer producing the strong *D*-emission covers a height interval 90–110 km; u.v. radiation of ~2 500 Å strongly absorbed by O_3 excites the twilight emission. D. R. B.

551.594 : 621.396.91 = 4 407

Origin of certain forms of atmospherics. RIVAULT, R. *C.R. Acad. Sci., Paris*, **226**, 1300–2 (*April* 19, 1948) *In French.*—Brief description of some simultaneous observations of atmospherics using two cathode-ray direction finding equipments at sites some 300 km apart. Daily observations for a period of a month during the autumn of 1947 are briefly discussed and different types of atmospheric are correlated with different phases of a storm. W. J. G. H.

551.594.11 : 551.576 407

Electric field intensity inside of natural clouds. GUNN, R. *J. Appl. Phys.*, **19**, 481–4 (*May*, 1948).—Measurements of the field on the surface of aircraft flying through all types of weather and clouds are summarized. The measured electric field inside a thunderstorm just prior to a lightning strike at 12 900 ft was 3 400 V/cm. The average max. field for 9 different thunderclouds was 1 300 V/cm. It is noted that large fields usually occur only inside the cloud and at altitudes somewhat comparable to the freezing level. Frequent reversals of the field are observed in these areas. The electric field measured inside a stable non-precipitating cloud is less than 10 V/cm. A.

551.594.12 : 551.510.535 407

Electric conductivity of the ionospheric *D*-region. MARTYN, D. F.; COWLING, T. G., AND BORGER, R. Letters in *Nature, Lond.*, **162**, 142–3 (*July* 24, 1948).—Martyn quotes experimental evidence in support of his suggestion [Abstr. 460 (1948)] against the objections of Cowling and Borger [Abstr. 2267 (1948)] concerning the variation with height of tidal motion. He also points out that the conductivity of layers below the *E*-region may be greatly increased by polarization set up by Hall currents. Cowling and Borger show that this can only be a partial effect.

551.594.2 : 621.315.1 : 621.3.015.3 407

A new theory of the induced overvoltages. SZPOR, S. *Conf. Int. Gr. Rés. Élect.* [*CIGRÉ*] (*Rep. No.* 308) 28 *pp.* (1948) *In English.*—[Abstr. 2614 B (1948)].

551.594.2 : 621.315.1.015.33 407

Lightning currents in transmission lines. GOLDE, R. H. *Conf. Int. Gr. Rés. Élect.* [*CIGRÉ*] (*Rep. No.* 311) 18 *pp.* (1948) *In English.*—[Abstr. 2663 B (1948)].

551.594.22 : 621.315.1 : 621.316.93 407

Lightning investigation on the 25-kV system of the West Penn Power Company. BOWEN, W. C., AND BECK, E. *Trans. Amer. Inst. Elect. Engrs*, **66**, 831–7 (1947).—[Abstr. 2693 B (1948)].

551.594.51 : 539.153 : 535.338.1 *see Abstr.* 3680

BIOLOGY 57/59

578.088 : 537.531 : 537.533 4078

Irradiation of biological materials by high energy Roentgen rays and cathode rays. TRUMP, J. G., AND VAN DE GRAAFF, R. J. *J. Appl. Phys.*, **19**, 599–604 (*July*, 1948).—X-rays and cathode rays of several million volts energy were applied in an investigation of their biological, photo-chemical and germicidal effects, particularly as they are related to the processing of foods and biological materials. A constant-potential electrostatic generator, together with an acceleration tube, was used to produce continuous streams of electrons with homogeneous and controllable energy [*Phys. Rev.*, **43**, 149 (1943)]. These high energy electrons were utilized both for the production of penetrating X-rays and for the direct irradiation of materials. The mechanism of the biological action of both X-rays and cathode rays is discussed, as well as the energy considerations in their application to various absorbers. A.

578.088 : 537.531 : 537.533 4079

Biological and photo-chemical effects of high energy, electrostatically produced Roentgen rays and cathode rays. DUNN, C. G., CAMPBELL, W. L., FRAM, H., AND HUTCHINS, A. *J. Appl. Phys.*, **19**, 605–16 (*July*, 1948).—A report on measurements [see Abstr. 4078 (1948)] of the lethal action of X-rays and cathode rays on a wide variety of micro-organisms and on the effect of the radiations on enzymes, vitamins and certain whole food products. (Bibliography of 66 entries.) A.

578.088.75 : 538.569.2.047 = 4 4080

Absorption of h.f. (21 cm) radiation by organic tissues. DE SÉGUIN, L., AND PELLETIER, M. *C.R. Acad. Sci., Paris*, **226**, 1048–50 (*March* 22, 1948) *In French.*—Various tissues of freshly killed horses were exposed to 21 cm radiation and the heat absorption determined from thermocouple readings. With the exception of brain, the absorption coefficient increased with the water content of the tissue. The radiation is >100× more penetrating than infra-red radiation. E. E. C.

MEDICAL SCIENCE . HUMAN PHYSIOLOGY 61

612.014.481.1.079 : 615.849 : 537.531.74/.92 4081

Physical basis for the high skin tolerance of supervoltage Roentgen rays. TRUMP, J. G. *Radiology*, **50**, 649–56 (*May*, 1948).—Experience with very high voltage X-rays has shown an increased tolerance of the patient's skin to the radiation which is here considered physically. The effect of radiation is due to the ionization produced by its absorption and scattering, with resulting production of secondary electrons, ionizing the atoms with which they collide and causing modification and destruction of the normal tissues. Fortunately the total number of ions formed by the radiation per unit volume can be measured with appropriate air chamber ionometers. Curves are given for the threshold erythema in relation to the kilovoltage of excitation of X-rays, which rise with kilovoltage, together with curves relating the ionization density with skin depth, showing that the intensity maxima become deeper with increased kilovoltage, so explaining the increased skin tolerance. This effect disappears when the beam of radiation has reached a distance equal to the range of the highest energy electrons produced, after which the average electron ionization is little different from that produced by lower voltage radiation. As a result the biological effect should only be less at the superficial skin tissues whereas, at greater depths, it is the same as with lower voltage radiation. The use of higher voltage radiation in practice permits increase of depth dose administered without undesired superficial reactions. B. J. L.

612.844 : 535.8 4082

An infra-red pupillometer. KOOMEN, M., TOUSEY, R., AND KNOLL, H. A. *J. Opt. Soc. Amer.*, **38**, 719–22 (*Aug.*, 1948).—A pupillometer for measuring pupil diameters in total visual darkness was constructed. It consists of an infra-red electron telescope arranged to observe the eye from a distance of about 6 in. An attached light source irradiates the eye with invisible infra-red radiation. A scale is projected into the field of the instrument to measure the pupil diameter directly. The instrument can be used in dim and bright visible light as well as in darkness. Other possible uses of the instrument for infra-red examination of the eye are suggested. A.

615.849 : 537.531.74/.92 : 612.014.481.1.079 *see Abstr.* 4081

GLASS . CERAMICS 666

666 : 535.345.1 *see Abstr.* 3698

666 : 539.213 *see Abstr.* 3961

666 : 539.389.3 *see Abstr.* 3981

666.1 : 535.327 *see Abstr.* 3675

666.1.037.5 : 539.4.016 : 535.55 4083

Stresses in two-wire glass-to-metal seals. ADAMS, O. *J. Soc. Glass Tech.*, **32**, 99–112 (*April*, 1948).—A brief discussion of the behaviour of glass in plane stress when examined in plane polarized light is followed by a description of the estimation, by Filon's graphical integration method, of the principal stresses in flat two-wire glass-to-metal seals. A.

METALLURGY 669

669.018 : 537.323 = 4 *see Abstr.* 3774

PHOTOGRAPHY 77

77.535 : 535.37 : 536.48 = 4 4084

The formation of the latent image at low temperatures. VASSY, A., AND VASSY, E. *C.R. Acad. Sci., Paris*, **226**, 1183–5 (*April* 12, 1948) *In French.*—A hypothesis is suggested on Meidinger's observations concerning the fluorescence of silver halide emulsions at liquid nitrogen temperature. [Abstr. 1548 (1940), 4303 (1939)]. The electron traps constituting the sensitivity specks are at a level close to the conductivity band of AgBr, those of the internal image are much deeper. The level of the sensitivity specks permits the return of electrons to the conductivity band even at low temperature. The electrons constituting the internal image fall back to the lower levels and cause the fluorescence observed. R. H. H.

771.535 : 537.13 : 539.164 = 3 4085

Production and properties of a photographic emulsion for the detection of charged particles. HÄLG, W., AND JENNY, L. *Helv. Phys. Acta*, **21** (*No.* 2) 131–6 (1948)

In German.—A detailed description of a laboratory-made nuclear track emulsion is given. The relationship between energy and range of alpha-particles emitted by natural radioactive substances up to 10·5 MeV has been established experimentally. The range of protons has been computed from that of alphas using the Bethe–Livingston formula. R. H. H.

778.3 : 539.164.93 *see Abstr.* 3902

778.3 : 539.165.2 *see Abstr.* 3905

778.3 : 551.593.5 4086

A test on the process of photographing the trajectory of a rapidly moving distant light source. NUSBAUM, R. E., AND BEGGS, J. S. Letter in *J. Opt. Soc. Amer.*, **38**, 740 (*Aug.*, 1948).—A light source (strength ~400 W) 8 ft above ground produced no visible trace on a photographic plate in a camera with 12 in f/2·5 lens 20 miles away when the image was moving at ~0·4 in/sec; but a trace of density 0·3 was produced under the same conditions when the source was at altitude 11 000 ft.

778.33 4087

Quantitative relations between the photographic response of X-ray films and the quality of radiation. HOERLIN, H., AND HICKS, V. *Non-Destr. Test.*, **7**, 15–19 (*Fall*, 1947).—X-ray sensitivity was determined as the reciprocal of the roentgen units (r) required to produce photographic density of 1·5 above fog at wavelengths from 0·01 Å (γ-ray source) to 1·27 Å. Effective wavelengths of the heterogeneous radiation were calculated from absorption measurements. The sensitivity was least for γ-rays rising sharply to a peak near 0·4 Å for all three film types used, with a slower fall towards longer wavelengths. The shape of the curves is discussed, and other curves derived in terms of incident energy instead of $1/r$. S. T.

778.33 408

A logarithmic step tablet for X-rays. CORNEY, G. E. AND SEEMANN, H. E. *Non-Destr. Test.*, **7**, 27–30 (*Fall*, 1947).—The usual method for comparison of X-ray films consists in exposing a strip of film under a metal step wedge of equal step thicknesses. This method has a number of disadvantages, largely due to the heterogeneity of X-ray beams, and the differential absorption of the metals. The new step wedge described aims at providing a series of exposures of constant ratio. An ordinary steel step wedge is first calibrated against a series of known exposures. From the curve obtained, the step thicknesses required to produce a difference in log relative exposure of 0·1 between each pair of adjacent steps are then determined. The wedge thus produced is finally adjusted by the addition of small thicknesses of aluminium to some of the steps. Each wedge must be calibrated with the particular X-ray machine on which it is to be used. It is claimed that the wedge can be used to compare a wide range of films exposed to radiation either directly or with calcium tungstate screens, to an accuracy of a few %. Comparing screen and direct exposures on the same film may lead to errors of 25%. Any single comparison should be restricted to films differing in speed by a factor of not > 5. J. E. R.

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SYMBOLS USED IN THE U.D.C.

: see "Note on the arrangement of Abstracts"
+ links subjects dealt with independently in the article
/ indicates extension over several numbers (e.g. 535.41/.43 represents 535.41 to 535.43 inclusive)
= signifies Language (e.g. = 3, in German)
( ) signifies Place (e.g. (485), in Sweden)
– is used to attach special analytical subdivisions applicable to certain sections (e.g. –31, ultra-violet; hence 535.34–31, ultra-violet absorption)
.0 indicates other analytical subdivisions applicable throughout Sections 53/59 (e.g. .08, measurement; hence 536.63.08, measurement of specific heat)
. Numbers are normally divided into groups of three figures by stops for convenience

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